SCDOT Specifications and Support Manual for GEOPAK Drainage

Last Revised: September 10, 2009

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I. Introduction

On April 17, 2000, the Hydraulic Engineering Section of the South Carolina Department of Transportation adopted GEOPAK Drainage as our primary storm sewer design package. Due to the many specifications that need to be set to run the program, the best plan was to write a manual to aid everyone using the software. It is not the purpose of this manual to provide you every piece of information needed to run the program. Additional resources are available through online help and training manuals.

Most of our other programs are much simpler to set up, so when misinformation is entered it can be easily found and corrected. GEOPAK has many settings that can cause the program to crash that you could spend several hours looking for that one incorrect specification. This manual was created to help avoid such **errors** and to set **standards** for naming conventions, levels, colors, etc. so our information would be easily transferable to the Roadway Designer. Never before has another office worked so closely with output from one of our programs. This is why it is critical that we are consistent with documentation so others can read our information.

This manual ***does not*** supersede the Requirements for Hydraulic Design Studies of the Department. **Careful** attention should be paid to those requirements and every effort made to adhere to them.

This manual utilizes the following workflow:

1. **Explanation of Files & Drives** and **Exchange of Information** are background information for the remainder of the manual.
2. **Download & Organizing Files** and **Uploading Files** are the steps involved in transferring data between Roadway Designer and the Hydraulic Designer.
3. **Create** a GEOPAK Drainage file.
4. **Design a Storm Sewer** contains the steps that you must follow to use the program.
5. **Special Discussions** details specific topics that require an expanded explanation.
6. The **Troubleshooting section** is designed to help you solve common problems that are easily corrected by the user.

SCDOT still possesses other storm sewer design packages, and there may be a time when one of these methods is the best solution for a particular situation. The Hydraulic Designer will make that determination. If you must use another program, please notify the Roadway Designer immediately to inform them that you will be submitting red lined plans for their use. Some information like riprap pads and outfall improvements will still need to be red lined. We will not be required to forward any Microstation files with notes.

GEOPAK Drainage, like all other hydraulic programs, gives you the best design and analysis based on the input. Engineering judgment must be used to evaluate the **output** that the program produces. You must check all data carefully and make determinations on the validity of the answers based on your knowledge of hydrology and hydraulics.

Do not be surprised to find that the program overrides some of your specifications. The program has the ability to change your **Preferences** and **Constraints** in order to **design** the system. The Preferences and Constraints are just guidelines to give the program a starting point to work with; therefore, it is imperative that you check all of your **output** for validity.

All specifications required to run the program will be added to this manual at the appropriate time. You will also be receiving updates for the storm sewer part as they are published.

NOTE TO CONSULTANTS: Consultants are to follow the standards set forth in this manual and the Requirements for Hydraulic Design Studies. The only procedural change that differs for consultants is discussed under **Downloading & Organizing Files** and **Uploading Files**. The consultants will obtain Road Design's files through the SCDOT FTP site and will send their data back to the Hydraulic Engineer, not the Roadway Designer, via CD or FTP. All other guidelines are to be adhered to as stated.

II. Drives

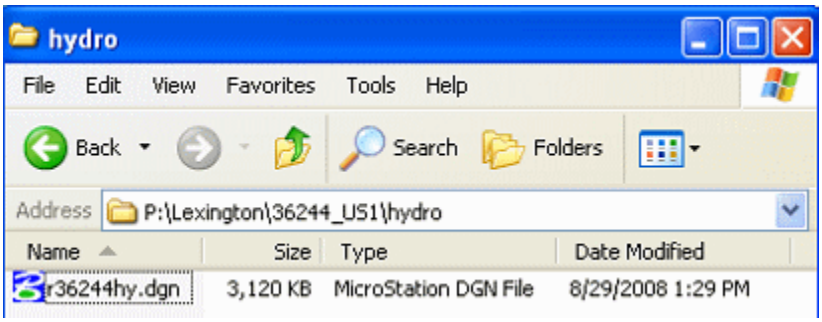
Network Locations and Workspaces

Preconstruction Data Folder Structure

P: \\nts\hq\precon

The hydraulic, roadway, and structural project files are consolidated by county on the network drive designated as the **"P"** drive. This drive serves as a central location for hydraulic, road, and structural CADD and data files that are project related and are sorted by county and pin number. New projects as well as current projects are stored at this location. \\nts\hq\precon

Example of a hydro folder located in Lexington County on the "P" drive

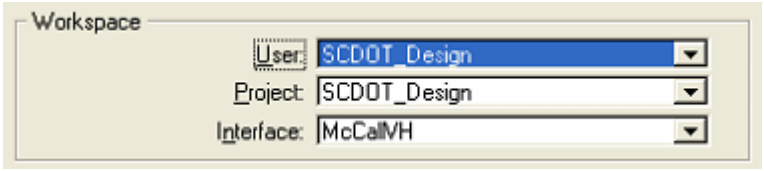


MicroStation and Geopak Workspaces

MicroStation and Geopak uses a custom workspace that is available to every CADD user. The workspace *automatically* controls access within MicroStation to the most current cell libraries, reference border sheets, drainage files, etc.

Network path for Level Names projects:
\\smpcadd1\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\

When entering MicroStation for a Level Names project, the User and Project should be set to SCDOT_Design with the Interface set to the NTS user name:



Network path for 63 Level projects:
\\smpcadd1\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design_63L\

When entering MicroStation for a 63 Level project, the User and Project should be set to SCDOT_Design_63L with the Interface set to the NTS user name:

GEOPAK Drainage specific files may be obtained under the **\Geofiles\Drainage** subfolder in the designated workspace for Level Names or 63 Levels.

Drainage Library (DLB)

The current version is: SCDOT_english_2008_09_Alt.dlb

Level Names:
\\smpcadd1\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\Geofiles\Drainage

63 Levels:
\\smpcadd1\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design_63L\Geofiles\Drainage

Cell Library (CEL)

Level Names:
\\smpcadd1\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\MSfiles\cell\RoadV8.cel

63 Levels:
\\smpcadd1\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design_63L\MsFiles\cell\library.cel

GEOPAK (DDB)

Level Names:
\\smpcadd1\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design\Geofiles\Database\scdot_engV8.ddb

63 Levels:
\\smpcadd1\CaddStandards\SCDOT-Bentley\Standards\SCDOT_Design_63L\Geofiles\Database\scdot_eng63L.ddb

II A. Files

Through GEOPAK Drainage we will read the *.GPK file that the Roadway Designer produces to obtain the pgl and chain files for placing drainage nodes. The Roadway Designer will provide the names for the centerline profile and chain, all side road profiles and chains, and any curb grade profiles. From these files GEOPAK Drainage will automatically read curb grades and identify the centerline stationing of mainline and side roads. The *.GPK file is extremely valuable. The *.GPK file will usually be named job###.gpk. The ### will be the last 3 digits of the pin number.

File Type:	GPK
Type	Binary
Acronym	GPK = **G**eo**P**a**K**
Use	Stationing, Profiling and Reporting

The pp.dgn file is the plan view of the project. It is shown exactly as surveyed. The pp.dgn file will usually be named *#####pp.dgn. The * is either "r", "m" or "c" and the ##### is the pin number. The .dgn is the designation for all Microstation design files.

File Type:	PP.DGN
Type	Binary
Acronym	DGN = **D**esi**GN**
Use	Plan View

The pf.dgn file is the plan and profile view of the project as it appears on the plan sheets. There will be more than one of these files for every project unless the project is very small. You will not need this file for GEOPAK Drainage. You may need to open these files to get tie equalities or look at some of Roadway Designer's notes.
The pf.dgn file can be named many different things. Some squads name them by the pin number, i.e. 12345pf.dgn, 1234apf.dgn, 1234bpf.dgn… Some squads name them by the road, i.e. sc100pf.dgn, sc100apf.dgn… The Roadway Designer will provide the names for these files.

File Type:	PF.DGN
Type	Binary
Acronym	DGN = **D**esi**GN**
Use	Plan & Profile View

This is the Microstation file that you will do all of your design in when running GEOPAK Drainage. You will need to create this file. Basically we will reference Roadway Designer's **pp.dgn** file into our created hy.dgn file. This will allow us to view the road, but our design

will be in another design file. If the Roadway Designer changes the **pp.dgn** file, it will not affect our design. This will be discussed in the **Downloading & Organizing Files** section.

File Type:	HY.DGN
Type	Binary
Acronym	DGN = **D**esi**GN**
Use	MicroStation file for Geopak Drainage design

The .new file contains a list of all surveyed points. In the past, the Hydraulic Engineer used this file to determine pipe elevations from plans. The .new is usually named a series of numbers with part of those numbers being the pin number. Any additional surveys submitted for the same project will follow the same naming convention but will add an A, B, C, etc. to the file name to be sent to the Roadway Designer. You will not need this file for GEOPAK Drainage.

File Type:	*.NEW
Type	Binary
Acronym	NEW = **NEW**
Use	Survey shots

The Cell Library is used for placing Drainage **Nodes** into the **HY.DGN** file

File Type:	*.CEL
Type	Binary
Acronym	CEL = **CELL**
Use	Used for placing Node Cells

The Design & Computation Manager database file can be used to compute drainage quantities.

File Type:	*.DDB
Type	Binary
Acronym	DDB = **D**esign **D**ata**B**ase
Use	Used for computing quantities

The .gdf is short for **G**eopak **D**rainage **F**ile. We will produce this file when we create a design in GEOPAK Drainage. It contains all of our **preferences**, **nodes**, **links**, **networks**, **profiles** and **output**. This file references our **Drainage Library**, **cell library**, and the Roadway Designer's **GPK File**. NOTE: The GDF file is not a Microstation file, but Microstation uses this

file to plot our basins and pipes. This is a file that you will upload for the Roadway Designer to aid them in labeling the plans. Name your .gdf files according to the naming convention discussed in the **New Project** section. The naming convention must be followed for consistency. You will only have one .gdf file per project. Even if you have multiple roads on one set of plans and you need to design storm sewers for all of them, you will still have only one .gdf file. Normal in-house projects have one designer assigned to that project, but consultant and large in-house rush projects will have several people working on them. If multiple people work on a project at the same time, then there will be multiple .gdf files. All .gdf files will need to be merged before they are sent to the Roadway Designer for labeling.

File Type:	*.GDF
Type	Binary
Acronym	GDF = **G**eopak **D**rainage **F**ile
Use	Stores the drainage components

The DRF file is the standard Drainage Report Format file created in-house that contains the information format that is required for our standard reports. When you run these files they will automatically generate the **CSV files** that contain the output data that you will cut and paste into our standard output files. The .drf files that you will need to run have been preset and are on the server. This will be discussed in the **Reports** section. These files are areastandard.drf, nodestandard.drf, linkstandard.drf, nodestandardroad.drf, linkstandardroad.drf, which need to be run for each storm sewer system, and nodesum.drf and linksum.drf, which are not storm sewer specific. The last two files mentioned are the summation of all the nodes and links, respectively, for the entire project.

File Type:	*.DRF
Type	Binary
Acronym	DRF = **D**rainage **R**eport **F**ormat
Use	Standard Report format for the output **CSV files**

The CSV file is the output file that you will make through GEOPAK Drainage that is readable inside of EXCEL™. It will only contain the information that the **DRF file** requested to be obtained. There will be multiple files for every **network** (storm sewer system); three for our records and two to send to the Roadway Designer. This will be discussed in the **Output** section.

File Type:	*.CSV
Type	ASCII
Acronym	CSV = **C**omma **S**eparated **V**alues
Use	EXCEL™ file

The DLB File is the **D**rainage **L**ibrary **F**ile. You will download a copy of this file into your project directory. This file is discussed in the **Drainage Library** section. You will send this file to the Roadway Designer after you complete your design for their use.

File Type:	*.DLB
Type	Binary
Acronym	DLB = **D**rainage **L**i**B**rary File
Use	Geopak Drainage Library file

This file will not email as is. You must zip it first in WinZip.

The TIN File is the **T**riangulated **I**rregular **N**etwork file and is used to represent the 3D surface either existing or proposed.

File Type:	*.TIN
Type	Binary
Acronym	TIN = **T**riangulated **I**rregular **N**etwork
Use	Stores 3d surfaces

The DAT File is a **Dat**a file and is used to store data as need to create the 3D surface **TIN file**.

File Type:	*.DAT
Type	Binary or ASCII
Acronym	DAT = **Dat**a
Use	Stores 3d surface points

The DEM File is a **D**igital **E**levation **M**ap and can be used to create the **DAT file** as necessary to create the **TIN file**.

File Type:	*.DEM
Type	Binary
Acronym	DEM = **D**igital **E**levation **M**ap
Use	Stores 3d surfaces

III. Exchange of Information

Per Instructional Bulletin No. 2005-8, you should receive the following information from the Roadway Designer to begin a design. The submittals from the Roadway Designer should be checked to ensure that all the information was received by the Hydraulic Engineer. The Hydraulic Engineer should also check to ensure that submittals to the Roadway Designer are complete.

Information to be Obtained from the Roadway Designer for the Hydraulic Engineer

Hard Copy

1. Cross Sections to scale on half size sheets
   a. Mainline
   b. Side roads
   c. Outfall ditches
2. Plan Sheets to scale on half size sheets
   a. Centerline final grades for mainline
   b. Final grades for side roads
   c. All outfall ditch surveys
   d. Limits of construction line
   e. All existing survey pipe recommendations

Electronic Copy

1. Project **.GPK** file
2. Project **PP.DGN** file
3. Project **PF.DGN** file
4. Project **.NEW** file
5. Centerline and top of curb pgl's.
6. Project curb grades

Information to be Provided for the Roadway Designer from the Hydraulic Engineer

1. Plan sheets stating which existing pipes are to be abandoned or retained.

Electronic Copy

1. Project **.GDF** file
2. Summary reports from GEOPAK Drainage listing information pertinent to roadway design
3. List of file locations and file names of requested information emailed to the Roadway Designer
4. Project **.DLB** Drainage Library file (if modified for project exceptions)

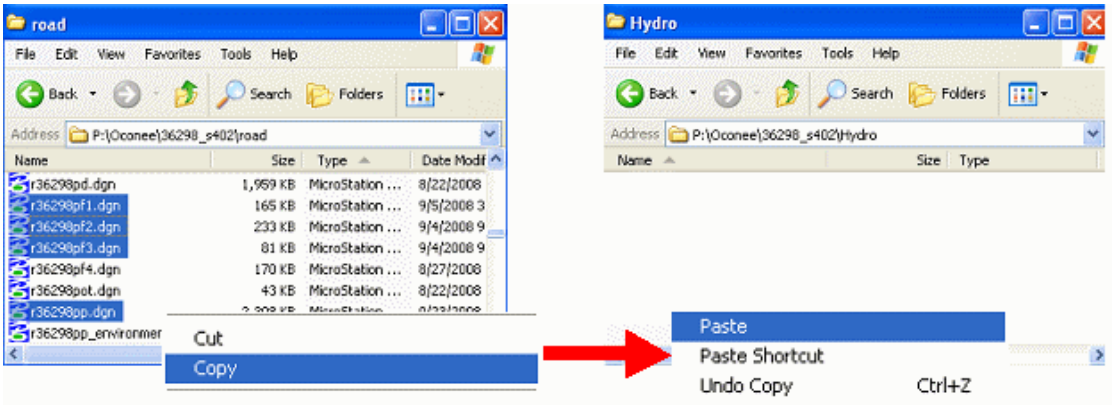
Explanation of common plan sheet items -- On the plan sheets, the limits of construction line is the cut/fill line. Also in the plan sheets, you will find the survey recommendations to abandon or retain a pipe.

IV. Downloading & Organizing

The Roadway Designer will email you a **hydrodata.xls spreadsheet** containing a list of CADD and survey files that you will need to copy from the project road folder to the hydro folder located on the "P" drive.

A	B	C	D	E	F
	ROADWAY DESIGN DATA FOR HYDRAULIC DESIGN				
	DATE: 8/18/2008				
DESIGN GROUP:	RPG 4 - UPSTATE				
PIN NO.:	36298				
COUNTY:	OCONEE				
ROAD/ROUTE NO.:	S-402 / SHEEPFARM RD.				
PROJECT DESCRIPTION:	WIDEN (SHEEPFARM RD.) EXISTING 2 LANES TO 5 LANE CURB & GUTTER WITH BIKE LANES AND SIDEWALKS ON BOTH SIDES. CONNECT SHEEPFARM ROAD TO SC 28 (BLUE RIDGE BLVD.) WITH NEW LOCATION STARTING AT S-135 (BOUNTYLAND ROAD).				
ADDITIONAL NOTES:	S-135 WILL BE WIDENED TO 5 LANE CURB & GUTTER AT THE INTERSECTION WITH SHEEPFARM ROAD. IT WILL THEN TIE BACK TO THE EXISTING PAVEMENT. STONEBROOK DRIVE WILL HAVE A VALLEY GUTTER. ALL OTHER SIDE ROADS WILL HAVE DITCH SECTIONS.				
		FILE INFORMATION			
	SERVER	DESIGN GROUP	COUNTY	PIN	
FILES LOCATED:	NTS/HQ/Preconf	RPG 4	OCONEE	36298	
'.GPK' FILE(S):	JOB298.GPK				
'PP' FILE(S):	R36298PP.DGN				
'PF' FILE(S)	R36298PF1.DGN		S-402 (SHTS. 6 - 13)		
	R36298PF2.DGN		SIDE ROADS (SHTS. 14 - 23)		
	R36298PF3.DGN		SIDE ROADS (SHTS. 24 - 26)		
'DX/FX' FILE(S)	S402DX.dgn	OFD1DX.DGN			
	S402FX.dgn	OFD1FX.DGN			
	S135DX.dgn				
	S135FX.dgn				
'SHAPE' FILE(S):	R298SH.DGN				
'.NEW' FILE(S):	36298.NEW				
	36298A.NEW				
CHAIN NAME	PROPOSED PROFILE	DESCRIPTION			
S402REL	S402RFP	CENTER LINE GRADE S-402 RELOCATION			
US76		CENTER LINE US 76			
BROOKLANER	BROOKLANERFP	CENTER LINE GRADE BROOK LN. REL.			
STONEBROOKR	STONEBROOKRFP	CENTER LINE GRADE STONEBROOK DR. REL.			

Navigate to the project directory on the "P" drive under the **road** subfolder. Highlight the files listed in the hydrodata.xls sheet by using the ctrl + click method to select multiple files at one time. Right click and select copy. Navigate to the **hydro** subfolder under the same project directory and right click and select paste.



For consultants, the Roadway Designer will put the same files on the SCDOT FTP site under the appropriate company name. The Roadway Designer will email the same hydrodate.xls template to the Hydraulic Engineer managing the project and they will forward it to the consultant.

IV.A. Hydraulic Engineering Files

You will need to download the english.**DLB Drainage Library** file from **Standard Files** onto your hard drive under your project directory.
You will need to create the hydrology file *#####**hy.dgn** (refer to **pp.dgn** for symbol significance). This can be done as follows:

1. Open the Roadway Designer's **pp.dgn** file in your project directory.
2. Go to **File>Save As…** under the Microstation menu and change the "pp" to "hy". Keep the other characters of the **pp.dgn** file name as they are.

You will need to manipulate the **hy.dgn** file that you just created. First, you need to delete all elements by following this procedure:

1. Zoom out until the whole project is on the screen.
2. Turn on all levels under **Settings>Level>Display**.
3. Go to **Tools>Main>Fence** and choose **Place Fence**. Draw a fence around the entire project.
4. In that same location choose **Delete Fence Contents**. Click the screen and everything will disappear.

Next, you need to reference in the **pp.dgn** file as follows:

1. Go to **File>Reference**.
2. Go to **Tools>Attach…** Choose the **pp.dgn** file in your project directory. When it asks for a logical name just enter a 1.
3. In the Reference window beside the **pp.dgn** that you just entered, put an √ under the **Snap** column. This will allow you to snap to the reference file, but not delete anything.

It should appear as if you are looking at the plan view of the project again. The greatest difference now is that you cannot manipulate anything currently on your screen. It is purely for viewing. Now the **hy.dgn** file is ready to use through GEOPAK Drainage.

V. Designing

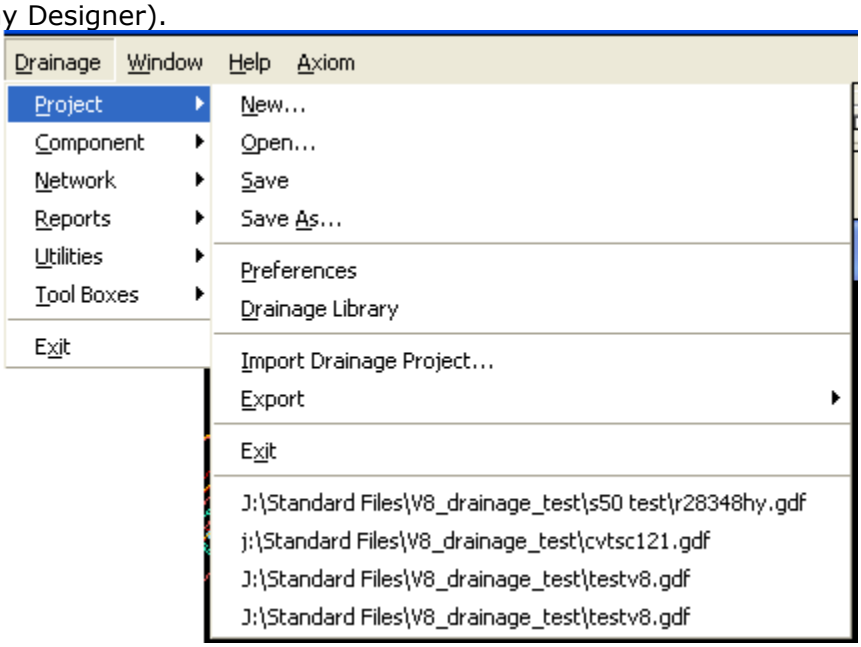
This section covers basic storm sewer design with GEOPAK Drainage. Be sure to check the GEOPAK on-line help for more specific information on each dialog.

If you need to convert an old V7 project to V8, to make design changes, see the **Converting V7 to V8** section.

V.A. Start a New Project

To start a new Drainage Project:

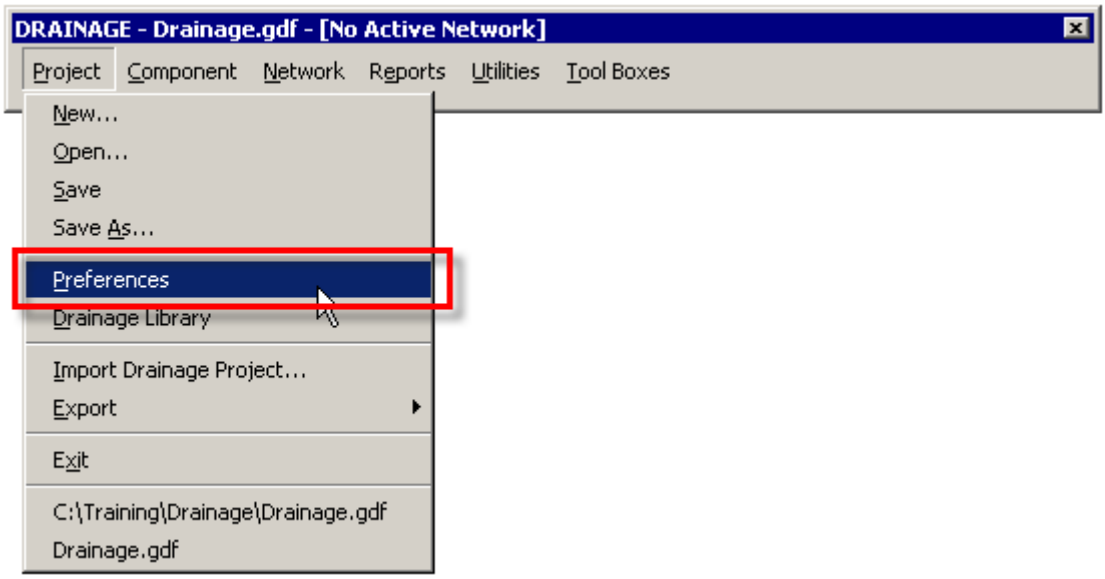
1. Open your **hy.dgn** Microstation file.
2. From Microstation, select Applications>GEOPAK DRAINAGE>Drainage (if GEOPAK is not activated select Applications>GEOPAK>Activate GEOPAK).
3. You should now have a new menu item by Applications titled Drainage.
4. Selecting Drainage>Project>Save As… Name the file after the road being improved, i.e. SC100.GDF (this is the **GDF** file that will contain all of your work and be sent to Roadway Designer).



GEOPAK Drainage always starts in an untitled project; it does not remember or automatically reopen a **GDF** that was previously worked in. The .GDF file must be reopened manually each time you open the **hy.dgn**. Select Project > Open each time you start to edit or continue working on a project.

V.B. Preferences

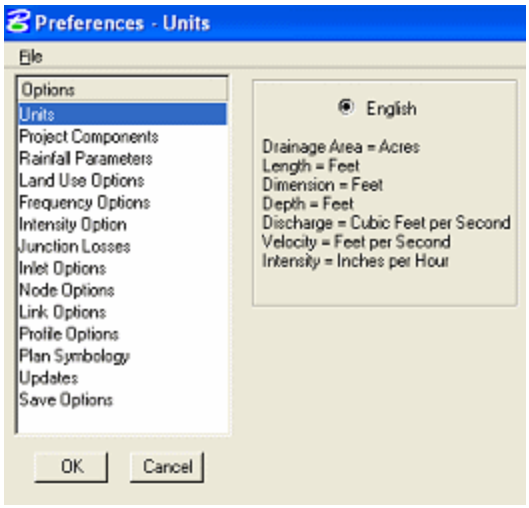
Set the Preferences as necessary at any time during project **design** or **analysis**, from the main menu bar select *Project* > *Preferences:*



See the individual Preference Options below.

V.B.1. Units

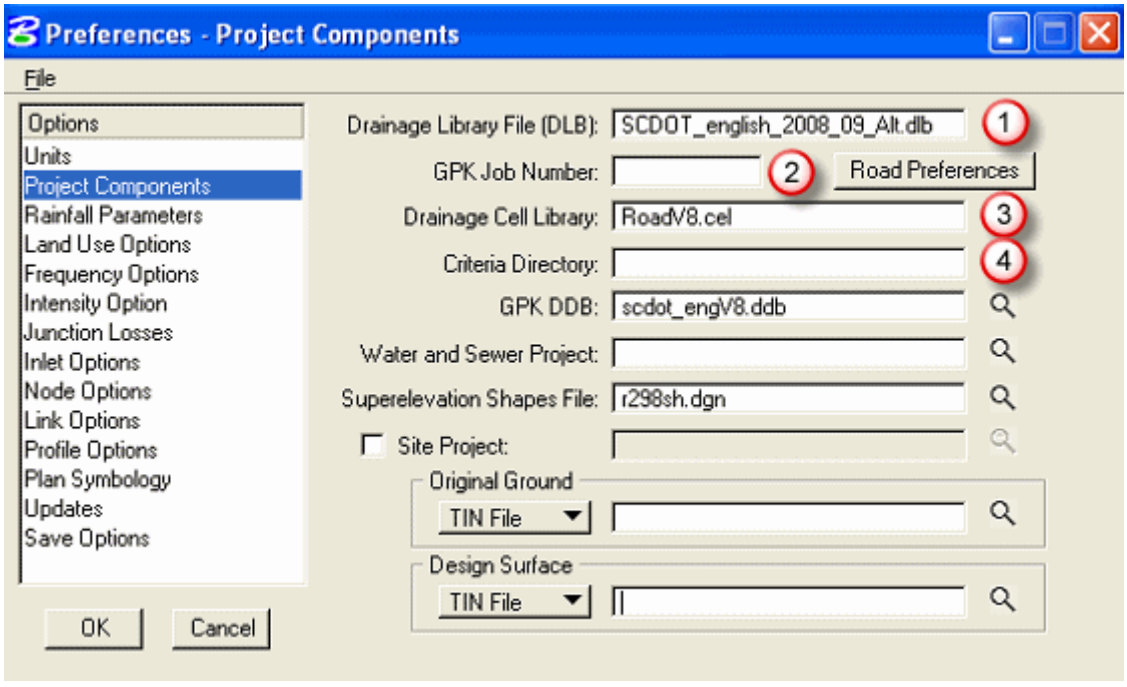
Set the Project Units to English:



V.B.2. Project Components

Set the Project Components:

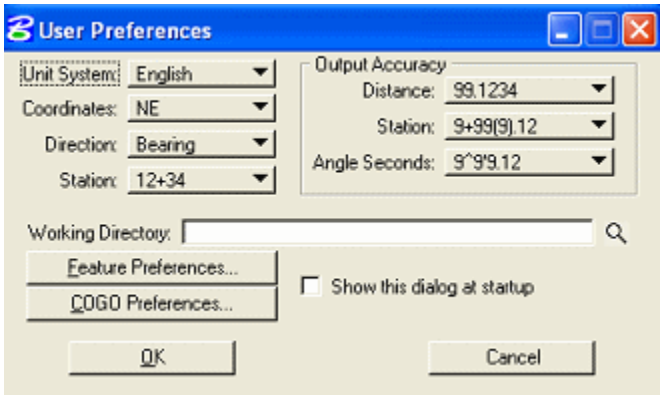
The DLB, CEL, and DDB can all be found in the workspace location . The r###sh.dgn file can be found in the hydro project directory.



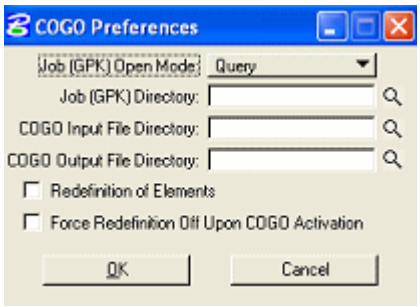
1	**DLB**	Click on the magnifying glass button and select the DLB file which was copied to the hydro project directory.
2	**GPK**	Click the magnifying glass button and select the GPK Job Number. You need to select your project directory and choose the file job###.gpk; there should only be one .gpk file. When you choose OK only the 3-digit number that was in the file name appears.
3	**CEL**	Click on the magnifying glass button and select the cell file located in the workspace folder. Select roadv8.cel for Level Names projects and select library.cel for 63 Level projects.
4	**DDB**	Click on the magnifying glass button and select the DDB file located in the workspace location. Select the scdot_engV8.ddb for Level Names projects and select the scdot_eng63L.ddb for 63 Level projects.

Leave all the other file locations blank.

Under the Road Preferences, be sure that the box for Working Directory is empty. This will ensure that your GEOPAK iterations write to the current working project directory – the hydro folder.

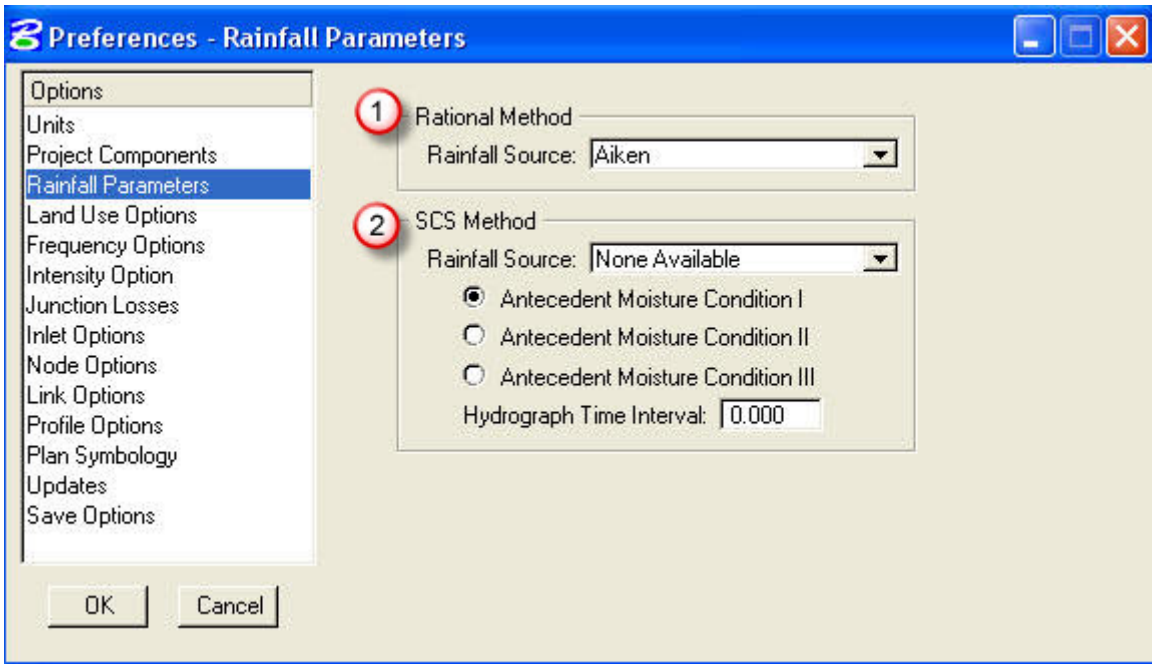


Press the COGO Preferences button and ensure that all three directories are empty also.



V.B.3. Rainfall Parameters

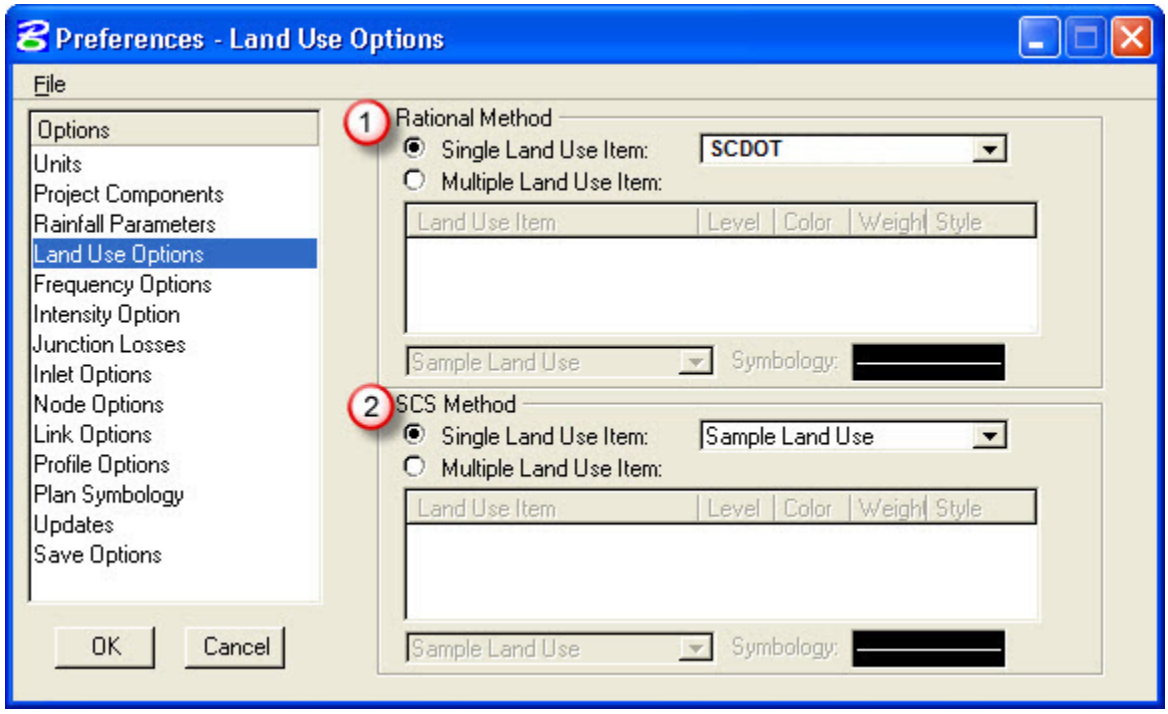
Set the Rainfall Parameters:



1	Rational	Choose the down arrow under Rational Method and a list of cities from South Carolina appears from the **Drainage Library** **DLB file** (choose the city that is closest to your site).
2	SCS	Ignore the SCS Method for now.

V.B.4. Land Use Options

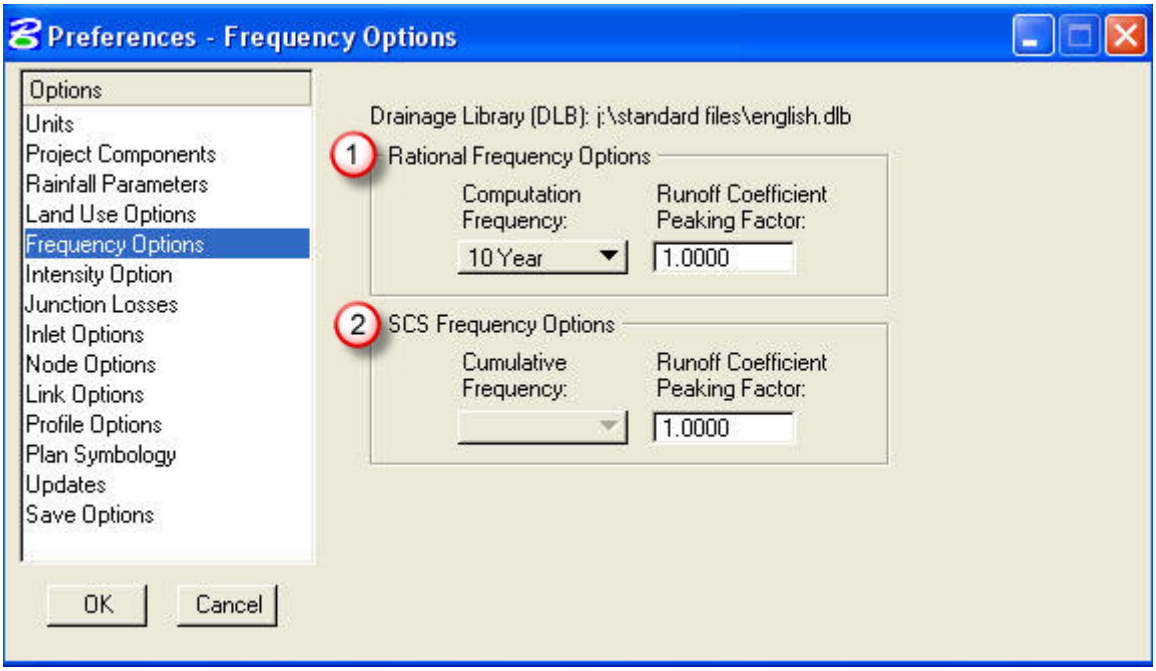
Set the Land Use Options:



1	Rational	The land uses are the "C" values associated with the different land uses and slopes throughout the state. If you have a design exception for a project, you will need to copy the Drainage Library (DLB) to your hydro project directory. You will then be able to input specific "C" values into the Drainage Library. Be sure to include this file in the Electronic Files to the Roadway Designer if you make modifications.
2	SCS	Ignore the SCS Method for now.

V.B.5. Frequency Options

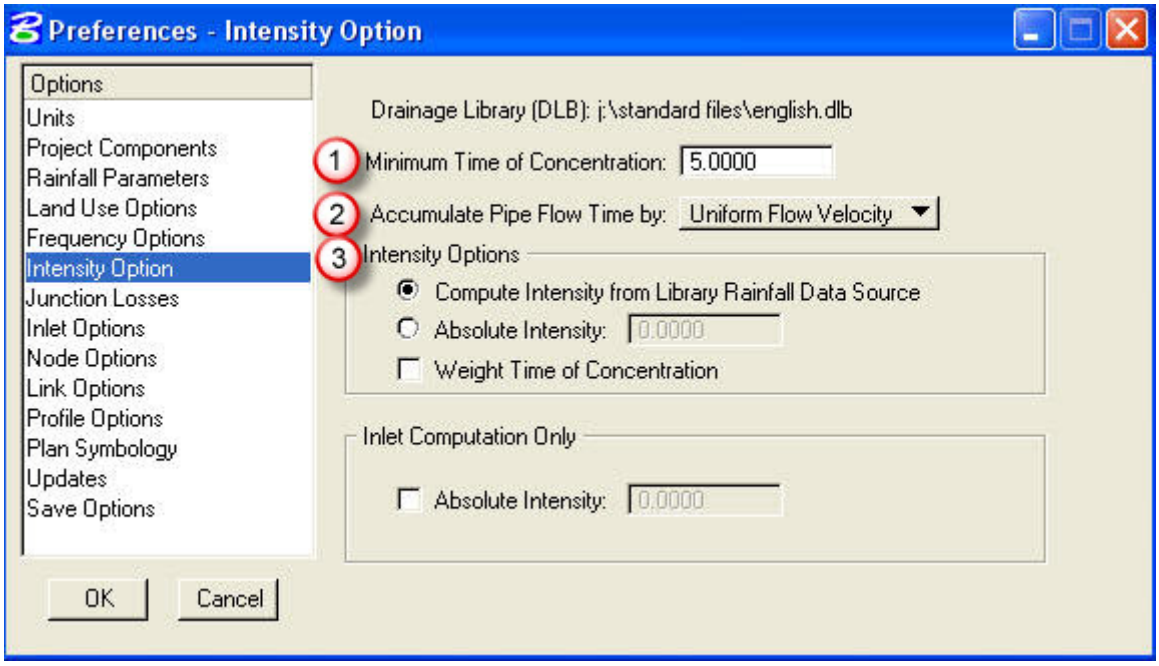
Set the Frequency Options:



1	Rational	Our basic storm sewer design is for a 10-year storm, but if cross lines are involved you will need to evaluate the storm sewer for a 25 or 50 year storm event. The **Drainage Library** has the values listed in it for the 10, 25, 50 and 100-year storms. You can only run one storm at a time, so initially choose the 10-year storm under Rational Frequency Options and input 1.0 as the peaking factor. If you need to run the other storms, simply choose that storm and input the correct peaking factor from the requirements for Hydraulic Studies.
2	SCS	Ignore the SCS Method for now.

V.B.6. Intensity Option

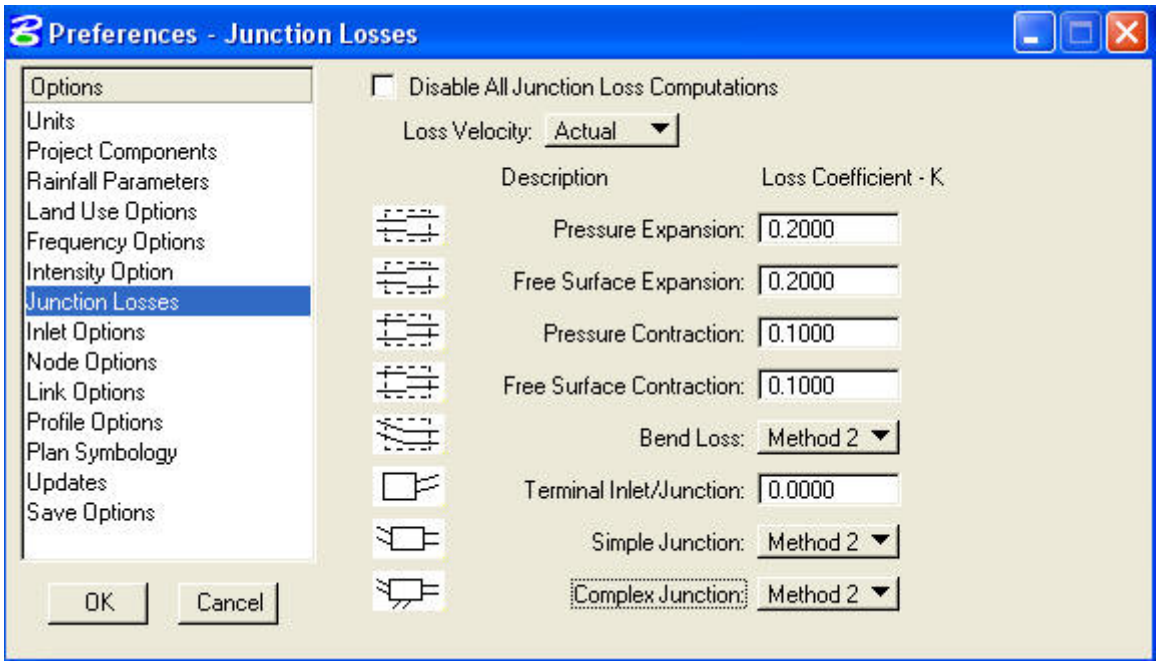
Set the Intensity Option:



1	Min Tc	Set the "Minimum Time of Concentration" to 5.0 minutes.
2	Accumulate Time by:	Under "Accumulate Pipe Flow Time by" select "Uniform Flow Velocity".
3	Intensity Options:	Always toggle **ON** the option to "Compute Intensity from Library Rainfall Data Source".

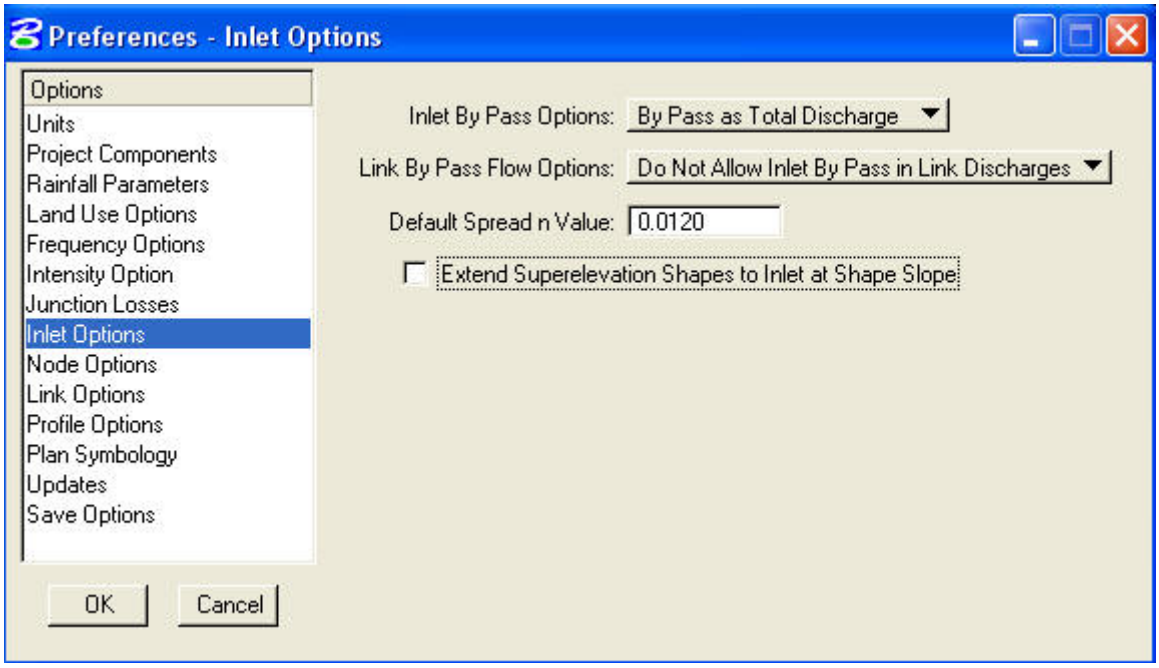
V.B.7. Junction Losses

Set the Junction Losses (use the values shown below for the Junction Losses):



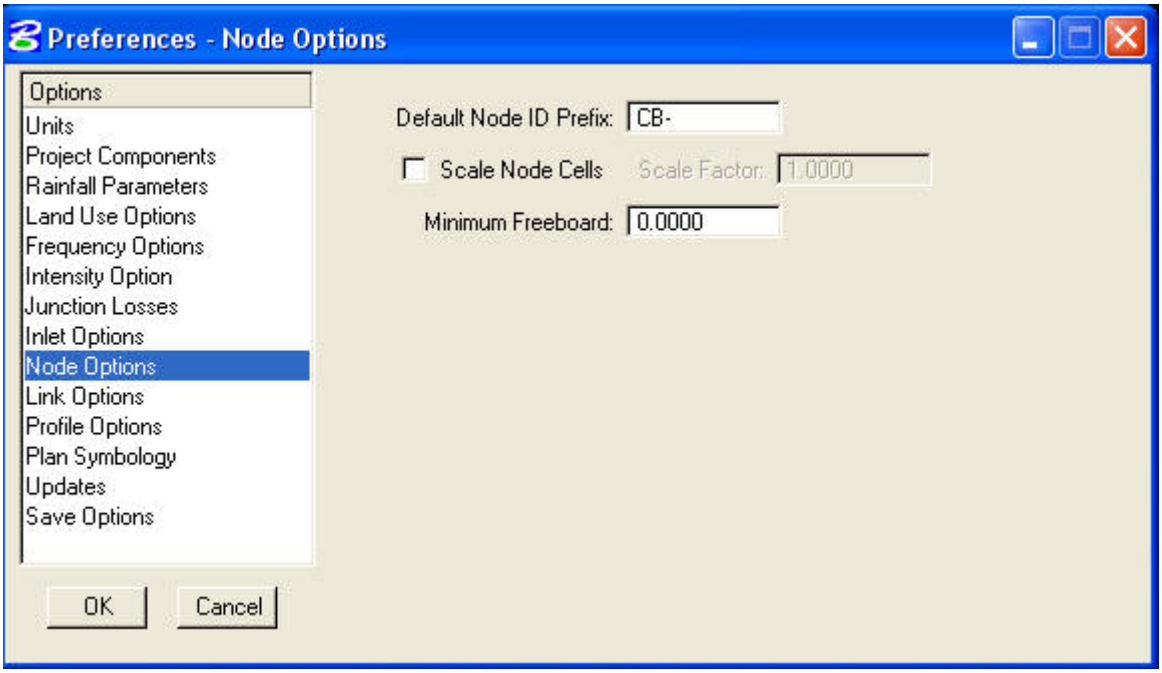
V.B.8. Inlet Options

Set the Inlet Options (use the values shown below for the Inlet Options):



V.B.9. Node Options

Set the Node Options:

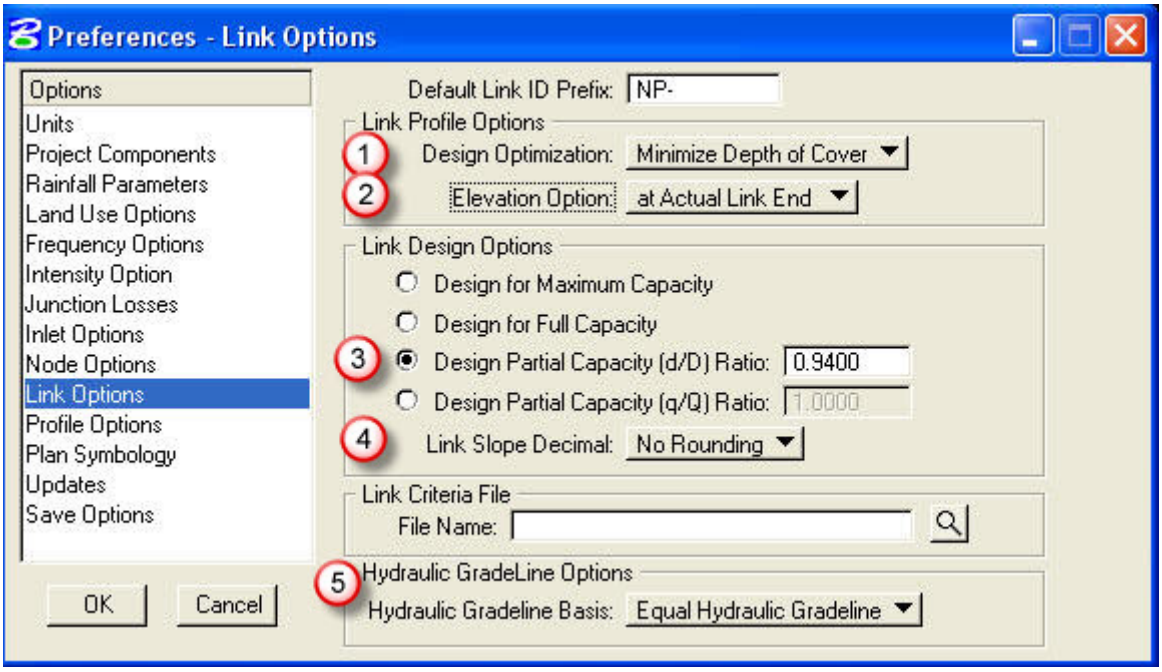


The Default Node ID Prefix will be different depending on the type of node being placed. Refer to the **Nodes** section and input the most commonly used prefix.

We need to be consistent with our naming conventions so we can easily read each others data and the Roadway Designer will not be confused by different symbologies.

V.B.10. Link Options

Set the Link Options:



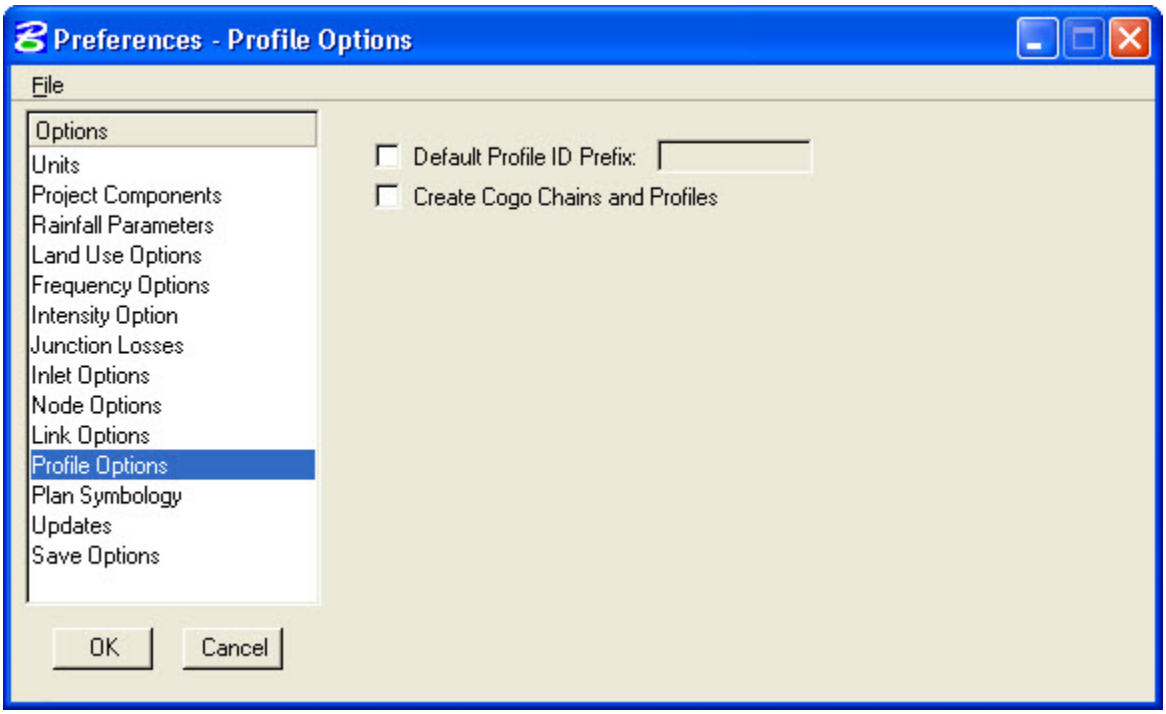
1	Design Optimization	Set "Design Optimization" to "Minimize Depth of Cover".
2	Elevation Option	Set "Elevation Option" to "at Actual Link End".
3	Link Design Option	Set "Link Design Options" to "Design Partial Capacity (d/D)" and set to 0.94 (i.e 94% full).
4	Link Slope Decimal	Set "Link Slope Decimal" to "No Rounding".
5	Hydraulic Gradeline	Set "Hydraulic Gradeline Basis" to "Equal Hydraulic Gradeline".

The Default Link ID Prefix will be different depending on the type of link being placed. Refer to the **Links** section and input the most commonly used prefix.

We need to be consistent with our naming conventions so we can easily read each others data and the Roadway Designer will not be confused by different symbologies.

V.B.11. Profile Options

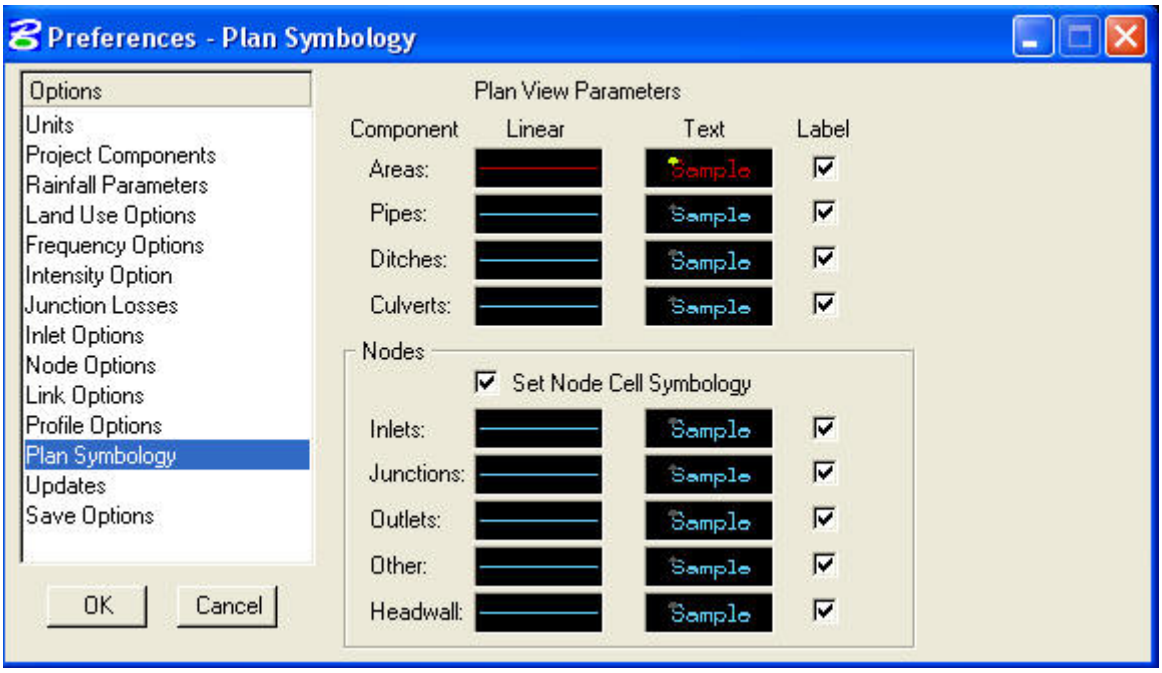
Set the Profile Options:



You can choose to have a prefix for all **profiles** that you create. For now we do not plan to create any **COGO** chains or profiles..

V.B.12. Plan Symbology

Set the Plan Symbology: We need to make sure our design is on levels that the Roadway Designer will not use. This way when they bring in our design there will be no confusion as to whose information is on what level. The labels will share the same attributes as its component. Make sure the following conventions are followed for levels, weight, line style, and colors for consistency:



For Level Name projects use the following symbology:

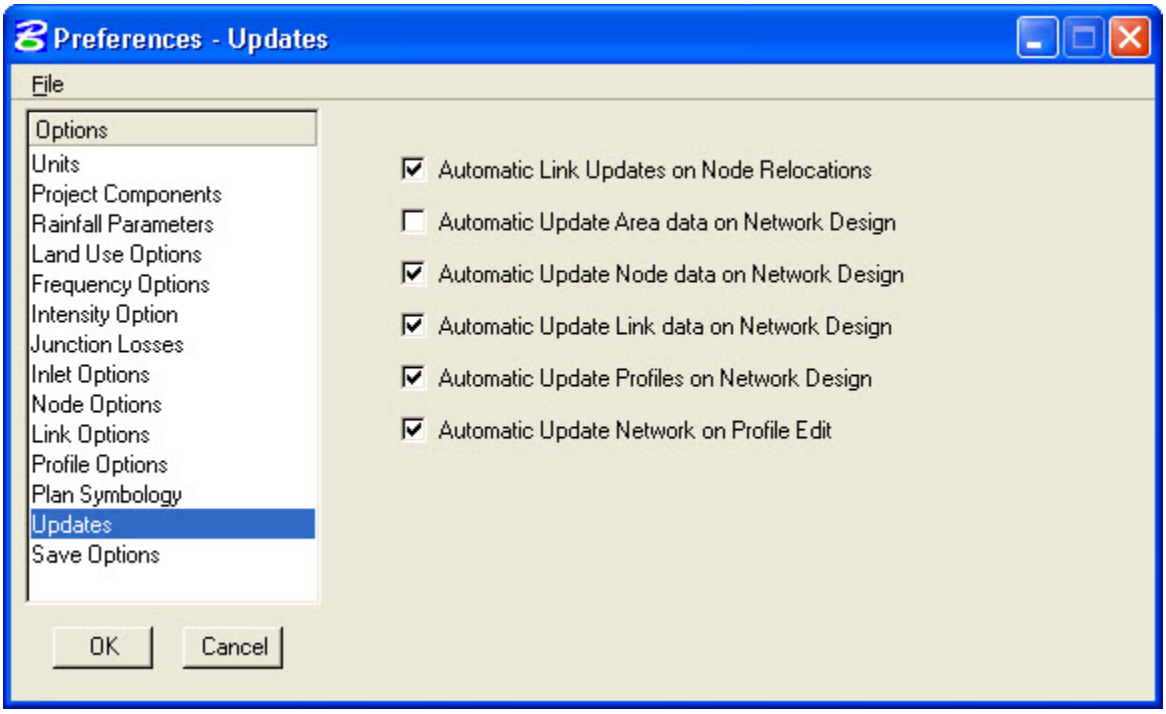
Attribute	Areas	Nodes	Pipes	Ditches
Level	RD_HY_Area_SS	RD_PD_DR_Inlet	RD_PD_DR_Pipe	RD_PD_DR_FlowCtrl
Color	3	106	106	106
Style	0	0	0	0
Weight	0	0	8	0

For Level number projects use the following symbology:

Attribute	Areas	Nodes	Pipes	Ditches	Culverts
Level	63	34	35	35	35
Color	3	106	106	106	106
Style	0	0	0	0	0
Weight	0	0	8	0	0

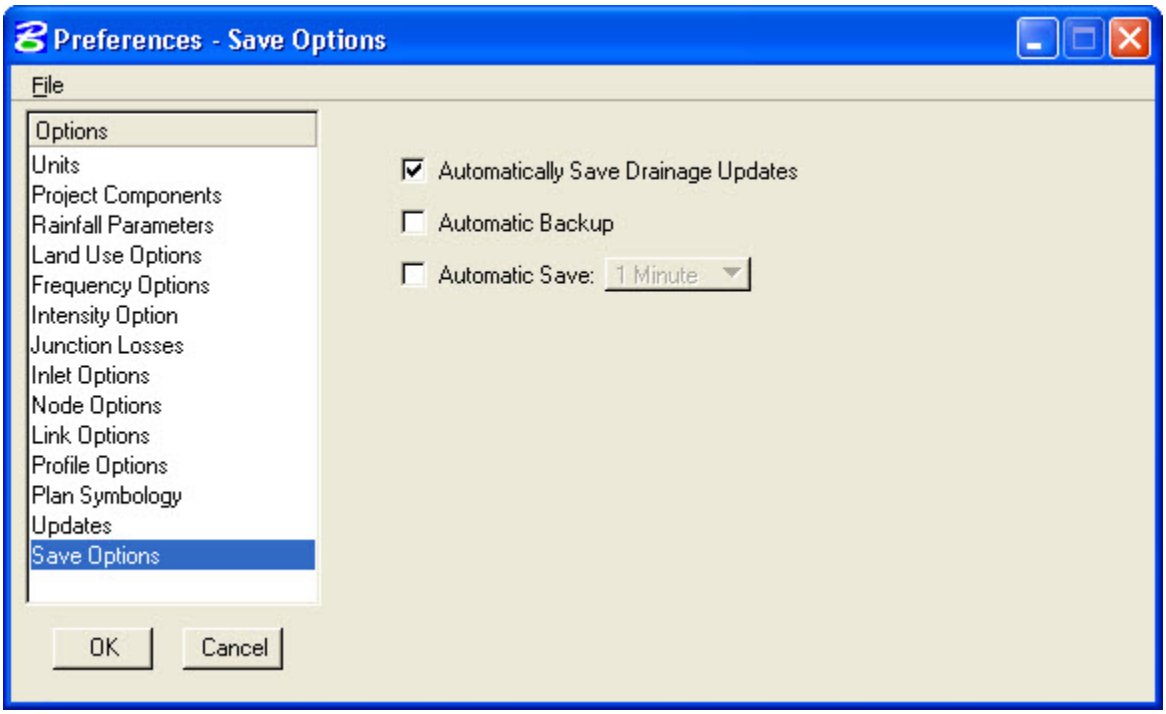
V.B.13. Updates

Set the Updates Options (use the settings below):



V.B.14. Save Options

Set the Save Options (use the settings shown below):

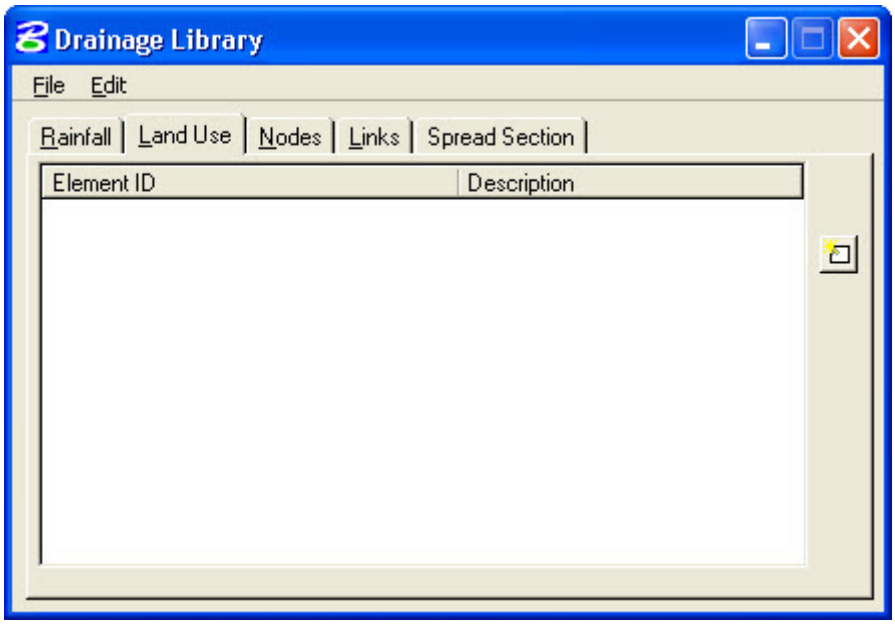


V.C. Drainage Library

Select Drainage>Project>Drainage Library. Make sure that the Drainage Library **DLB File** for your active **GDF File** is open. If not, then go to File and choose the correct one. There are five tabs – Rainfall, Land Use, Nodes, Links, Spread Section. Rainfall, Nodes, Links, and Spread Section have been preset and need not be modified.

Use the Land Use Tab to view the land uses on your project.

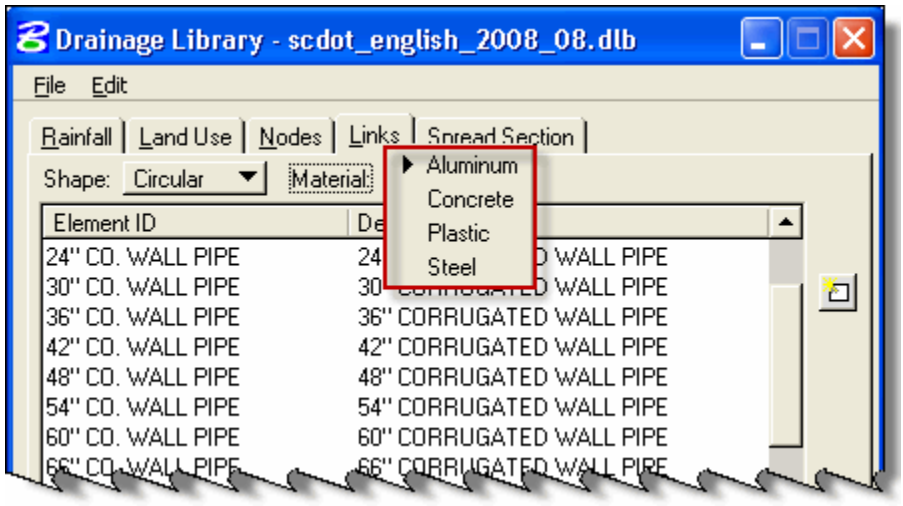
Entering drainage areas will be discussed in the **Areas** section. For detailed information on Land Use, go to the on-line help.



V.C.1. Link Specifications

Circular Links can be the following material types: Concrete, Aluminum (Corrugated Wall Pipe), Plastic (HDPE), Steel (Smooth Wall Pipe).

Steel pipe is also known as Smooth Wall Pipe due to its low coefficient of friction and can be used as an alternate pipe type in lieu of Concrete.



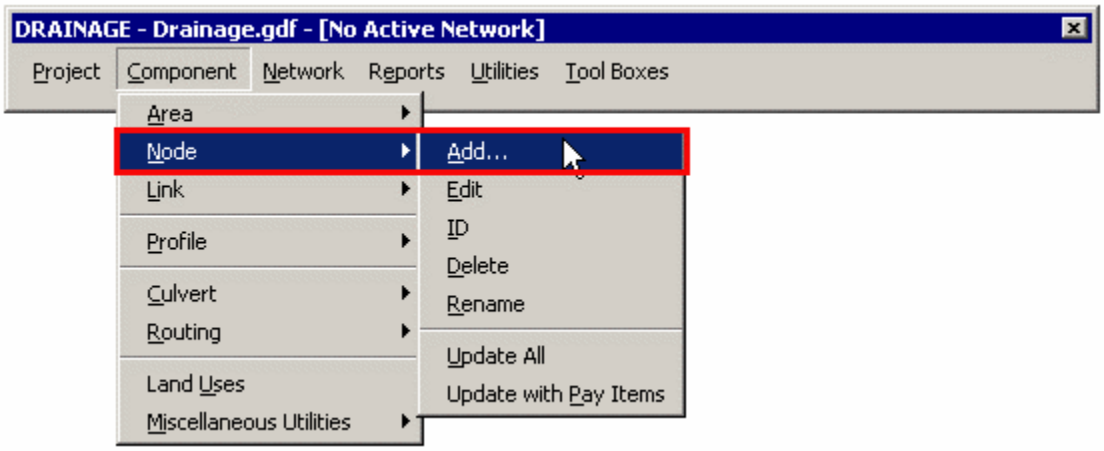
V.D. Nodes

A node represents any new or existing catch basin, drop inlet, junction, open-end pipe or outlet. Each has a **cell** symbol through GEOPAK that represents that particular node. All nodes appear large in the **Drainage Library**, but some intentionally plot as a dot and are only visible when you zoom in closely. Outlets, pipe ends, and existing structures do not need a visible mark. Outlets and pipe ends are defined by the line drawn for the **pipe**. Existing structures are already defined by the Roadway Designer and we want to avoid an overlap of cells. All nodes will have a visible label when placed, and you can always select a node by its label.

Note that GEOPAK Drainage does not automatically space your basins; you must use our spacing charts. To aid in finding low and high points, refer to the **Special Discussions** section on COGO.

It is best to place all of your nodes for a system before adding **links**; then if you need to add more nodes you can do so without having to move links.

To add nodes go to ***Drainage>Component>Node>Add***. The "Add a New Node" dialog will open for each Node asking for a Node name prefix and number. They number automatically increase linearly from 1 to 10000.



Notice in the **Node ID** that it is using the default that you set in **Preferences**. You may need to change this. The following chart will aid you in the naming conventions:

New Node:

Node Type	ID Prefix
CB Type 16,17,18,1,9,12,14,15	CB
DI	DI
Tee Joints	T
MH, JB	J
Dummy Nodes	DN
Outlet	OP
Water Quality Structure	WQS
Bends (15,30,45,90)	B
Wye	Y
Multi-grate	MG
Rebuild Existing Structure	RB

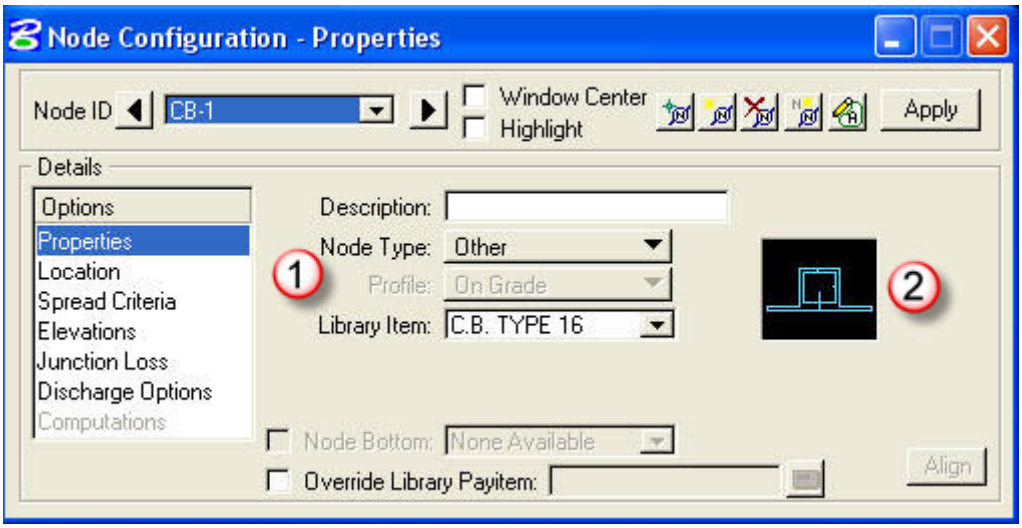
Existing Node:

Node Type	ID Prefix
All CB, DI, Tee Joints, MH, JB, Dummys*, Outlets, Water Quality Structure, Bends, Wye	EX

* A dummy node defines pipe ends. It can also represent existing structures that do not have cells; however, cells do exist for existing manholes, drop inlets, and catch basins.

V.D.1. Properties

Set the Properties of the Node (the Description field is optional):

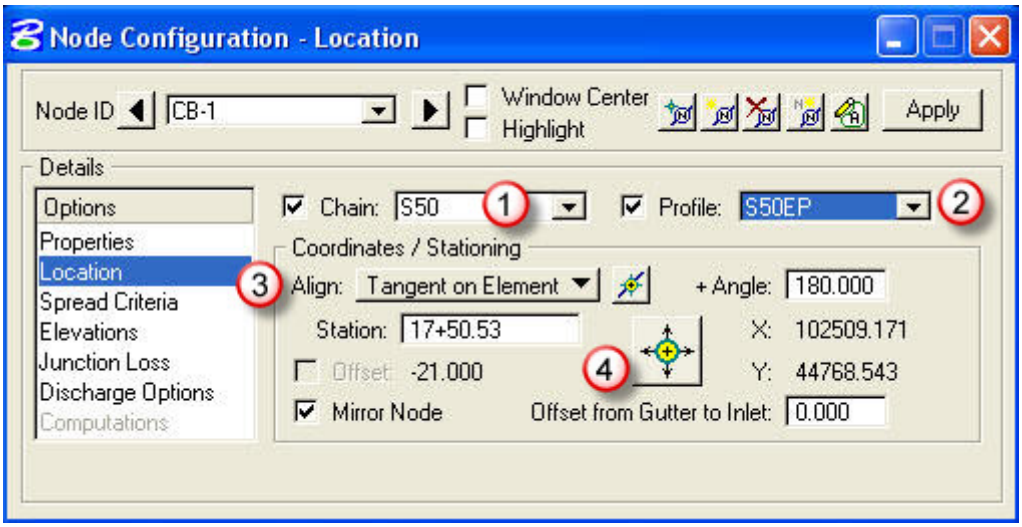


1	Node Type	Choose the appropriate "Node Type", "Profile", and "Library Item" to be placed from the **Drainage Library**
2	Preview	Ensure the correct **cell** is shown in the preview window

If placing a Tee or a Bend, initially choose the Tee or Bend that has the description "generic". After the design is finalized go back and reselect the Library Item to the correct size of Tee or Bend. Make sure you adjust the inverts at the Tees if you have a different trunk line pipe size. For Tees, the trunk line is listed first and the stub is second. If you are entering the outlet node, this is where you would define the tailwater.

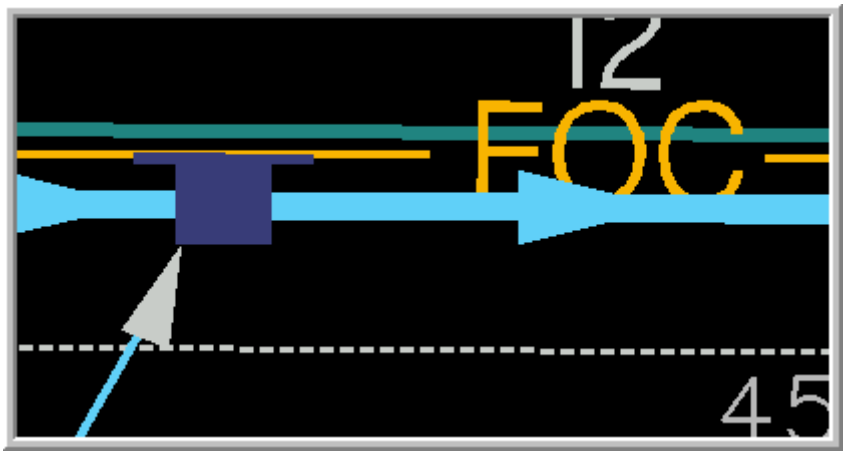
V.D.2. Location

Set the Location of the Node:

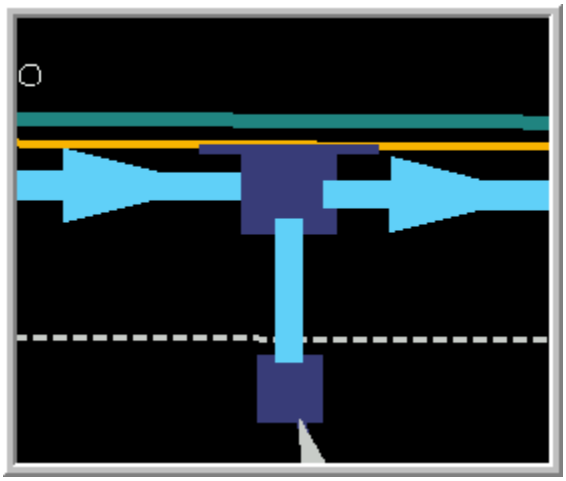


1	Chain	Use the pulldown arrow to select the correct chain name. This information comes from the **GPK File** that you downloaded, and the Roadway Designer will list in the spreadsheet what chain represents which road. If you are placing a node on a side road make sure to use the corresponding side road chain name.
2	Profile	Use the pulldown arrow to choose the correct profile name. Once again this information will come from the **GPK File**, and the Roadway Designer will list in the spreadsheet the names of the left and right top of curb grades. You will use top of curb grades to define the starting elevation of the catch basin for all basins on curb.
3	Alignment	Set the **Align** to **Tangent on MS Element** for all nodes that will be flush with the Face of Curb (FOC). Then click the **Select** button by Tangent on MS Element and select the FOC line which will also automatically set the offset distance.
4	Placement	Either enter the Station value or click the large **PD** button to dynamically place the node cell

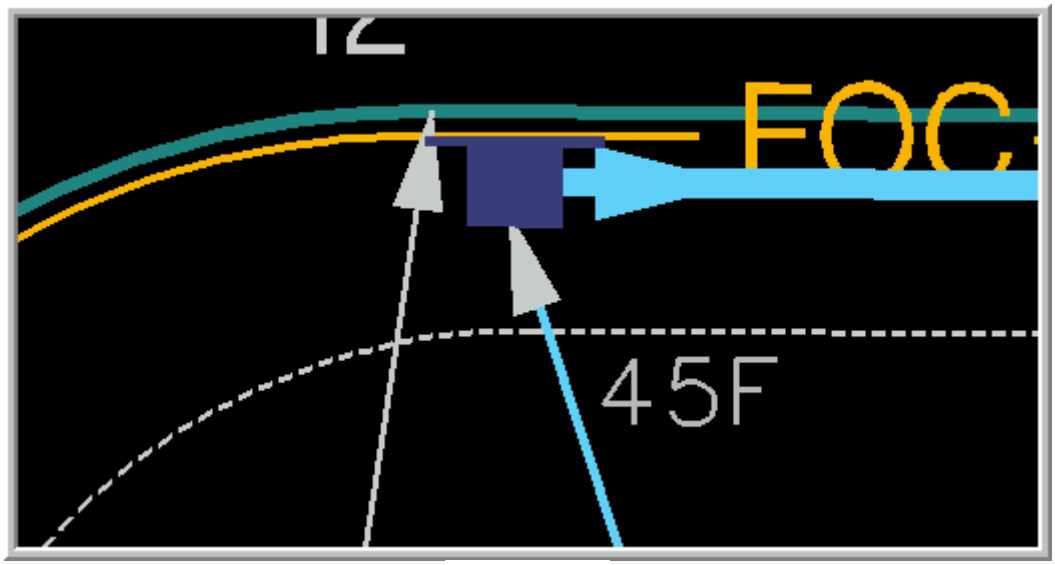
To be consistent with the Roadway Designer the following picture represents where the cell should actually be placed when on the curb. If you place nodes as instructed previously, the cells will match perfectly with the FOC as shown below:



The image below exhibits how to place a drop inlet against the fill. Offset the inlet approximately one foot from the toe of fill, but do not measure the one foot distance, just get close. The important thing is to not place the inlet flush against the fill line.



The image below exhibits how to place a cell at a radius. Place the beginning of the throat at the radius point allowing the entire inlet to be constructed along the tangent section outside of the radius.



We need every **cell** in its proper location because the Roadway Designer cannot move our cells around; this would violate our design and they will have trouble with labeling. Please be conscience of every cell location. Once you get a feel for it, it will not take but a second to get the cells located correctly.

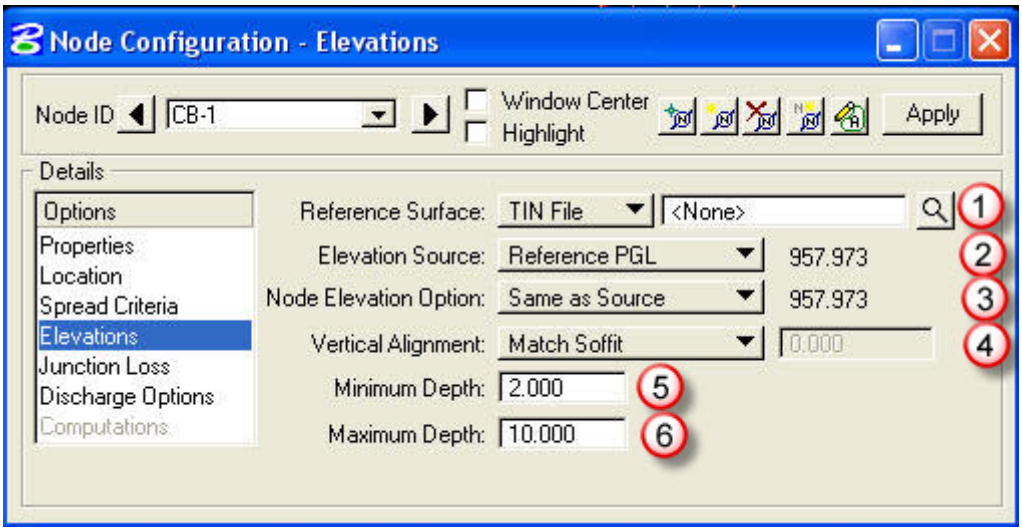
V.D.3. Spread Criteria

N/A for SCDOT Drainage design.

SCDOT does not enter any information in this window. An **error message** may appear due to spread. This message should be ignored.

V.D.4. Elevations

Set the Elevation of the Node:



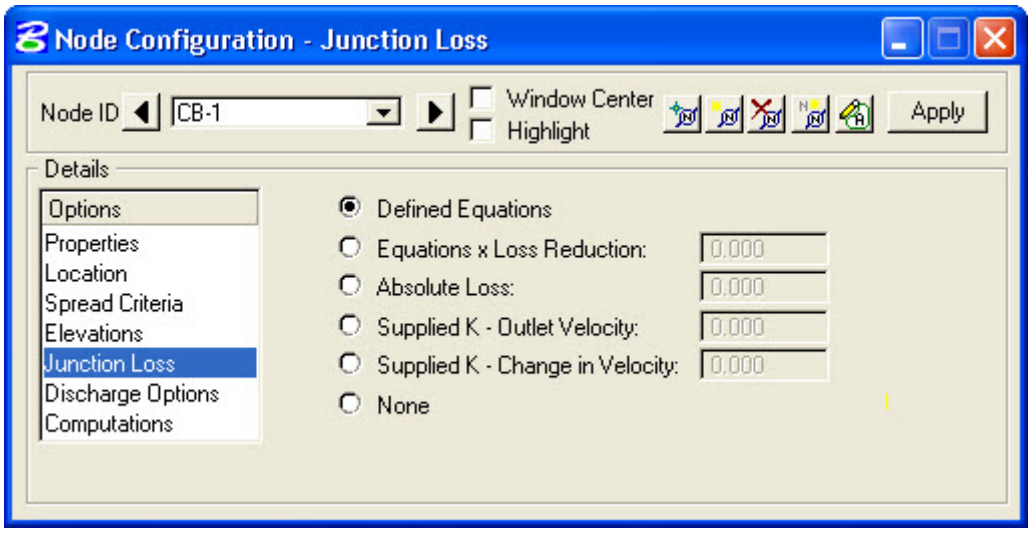
1	Reference Surface	If using a TIN file enter it here, otherwise leave blank
2	Elevation Source	Select "Reference PGL"; an elevation will automatically appear (this is the top of curb elevation and it is read from the Profile you entered previously in the **Location** option). If the **cell** is not on the curb, you will need to choose "User Supplied" and enter the elevation. For a drop inlet enter the ground elevation. The outlet is discussed in detail under **Special Discussions**. A stub out or open end pipe elevation will be determined following the same procedure used for the outlet.
3	Node Elev. Option	Set to "Same as Source";
4	Vertical Align	Start with "Match Soffit" but change as needed for drop manholes or matching flowlines, etc.
5	Min. Depth	The Min Depth varies per Node type (see table below)
6	Max. Depth	Enter 10'. If you get a warning message, you have exceeded your maximum depth; in this case special consideration will be required with the road designer.

NODE	Min. Depth	
	From TOC	From Ground
Water Quality Structure	-	0.0’
CB 1, CB 15, CB 16, DI 115	2.0’	-
CB 17, CB 18	3.0’	-
DI 24x24, DI 24x36, DI 112	-	1.0’
CB 9	-	2.0’
MH	-	3.0’
Outlet, Dummy	0.0’	0.0’

Designer should always consider the maximum pipe diameter appropriate to fit drainage structures listed in the SCDOT Standard Drawings and be aware that exceeding these limits may require custom designed boxes.

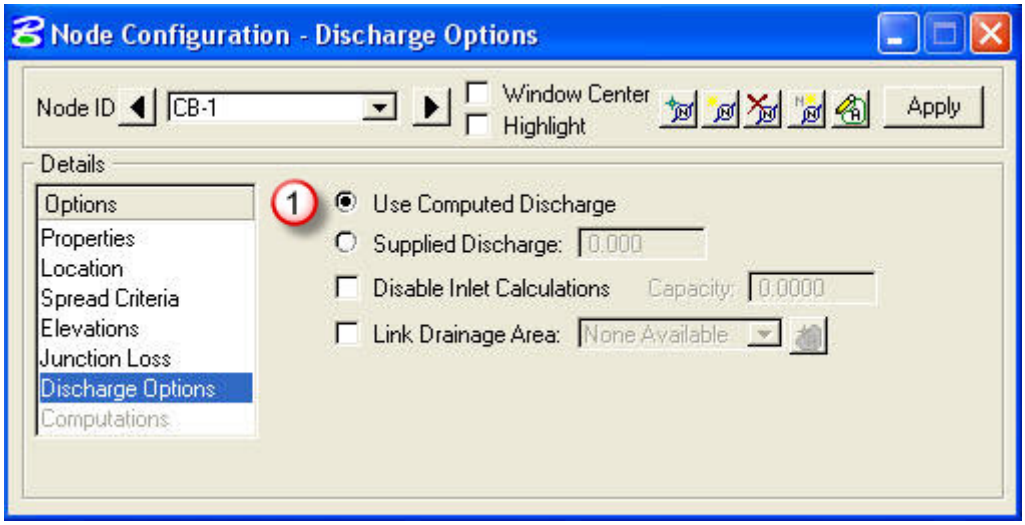
V.D.5. Junction Loss

Set the Junction Losses (use the Defined Equations option as shown below):



V.D.6. Discharge Options

Set the Discharge into the Node:

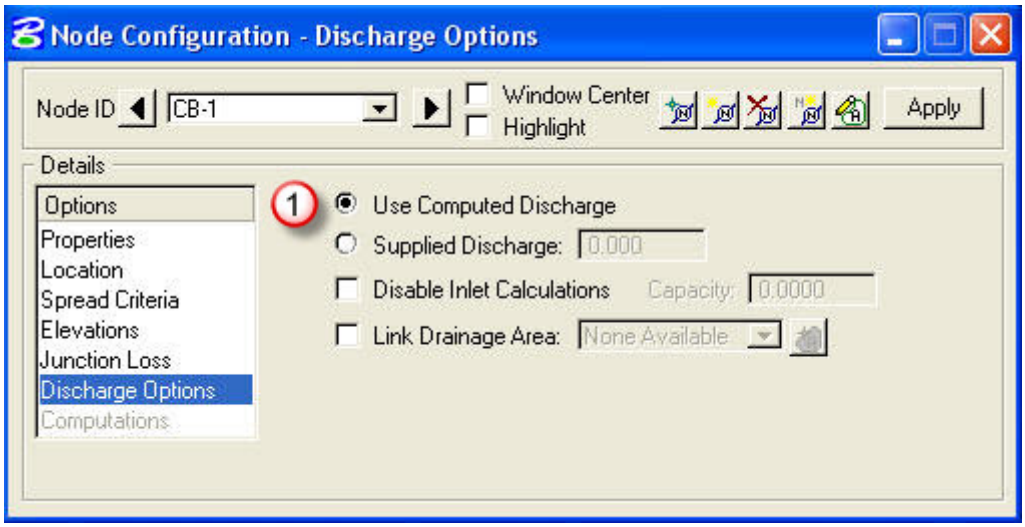


1	Discharge	Set to "Use Computed Discharge" for almost all situations so the **area** discharge is directed towards the node.

Some drop inlets and cross line pipes require a "Supplied Discharge", in which case enter the discharge value in the key-in field.

V.D.7. Computations

Note that the Computations Options are not applicable:



Since SCDOT does not let GEOPAK calculate the **spread**, this option will ***not*** be available. Otherwise, view the computations.

Only select the **Edit Area** button if your node collects water. Junctions, outlets, and water quality structures cannot collect water. When you select this button (located just to the left of the Apply button) it will tell you that this area does not yet exist and ask if you want to create it. Answer "yes". The **Add a New Area** box will appear. The **Area ID** is whatever you named the node; do not change this. You can add a description if you desire, but it will only be used to describe the area and not the node.

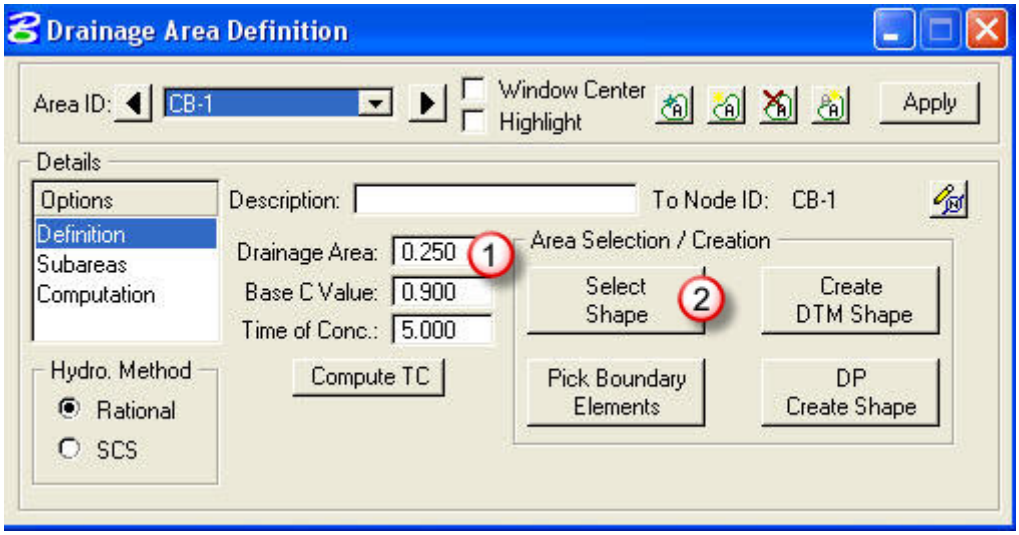
V.E. Areas

See the individual Area options below.

SCDOT uses the "Rational Method" only.

V.E.1. Definition

Define the Drainage Area:



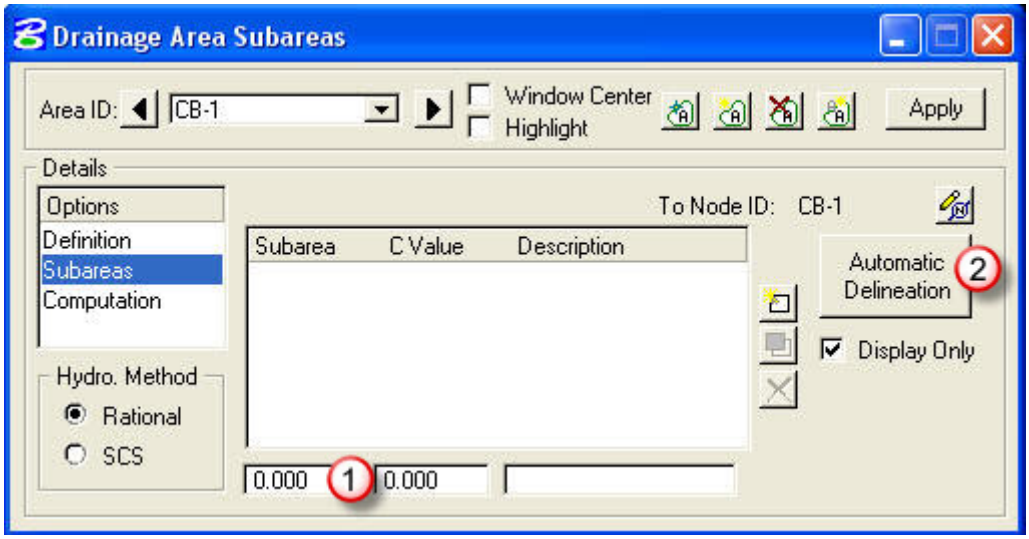
There are four methods of inputting areas for a basin; use one of the two below, or for more info see the full Geopak Drainage Manual on the server.

1	Drainage Area	Just key-in the acreage in the key-in field
2	Select Shape	Draw a MicroStation closed shape, then click the Select Shape button, identify and accept the shape, and the acreage key-in field will automatically populate with the acreage value.

Also enter the **Base C Value**, and the **Time of Concentration**. Disregard the **Compute Tc** button for now; it is being tested by SCDOT.

V.E.2. Subareas

Set the Drainage Area's subareas option:



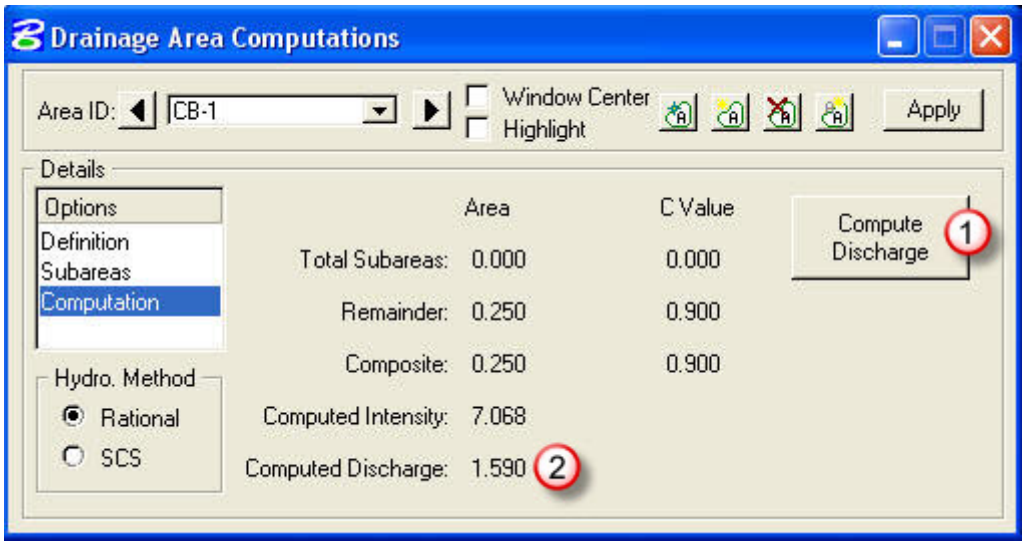
There are three methods of inputting subareas into a basin; use one of the two below, or for more info see the full Geopak Drainage Manual on the server.

1	Manually	Just key-in the subarea "c" values and acreages in the key-in fields and use the add/modify/delete buttons to effect the entries in the list
2	Automatically	Click the **Automatic Delineation** button, which initiates a scanning of the **DGN file** (*and references files*) within the main **drainage area** for closed shapes matching the symbology of the **Library Land Uses** as selected in the **Preference Land Use Option**, and automatically populates the Subarea Table.

The final subarea is the "Base C Value" entered in the **Definition** option.

V.E.3. Computation

Check the Computation option, as shown below:



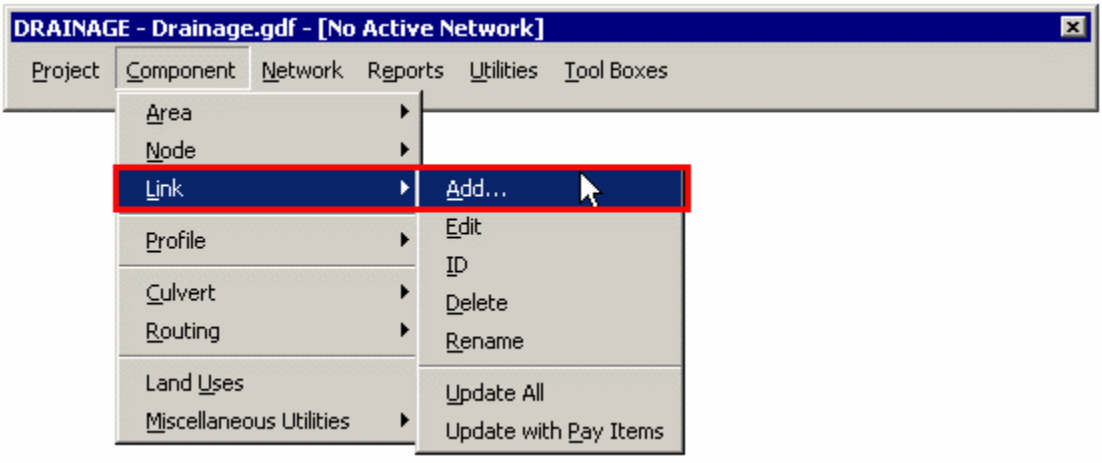
1	Compute Discharge	Click the **Compute Discharge** button to initiate the computations
2	Results	Verify the Drainage Area computation results in the *read-only* dialog

This is just the discharge value for this individual node, and ***not*** the discharge in the **pipe**.

V.F. Links

Links can be pipes or ditches. At SCDOT, the Geopak Drainage ditches are used for analyses only and not for auto-designing.
There must be two **nodes** of any type already placed in order to define a link.

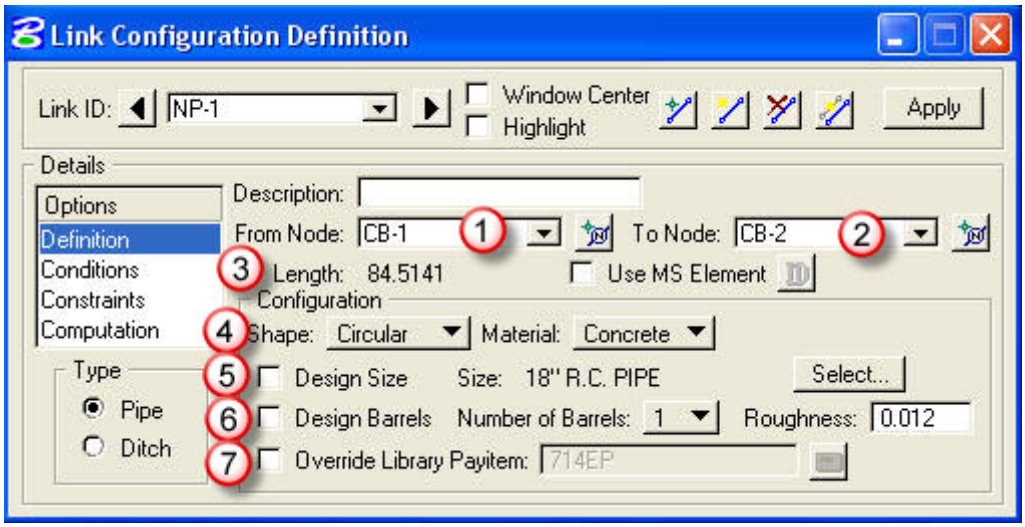
To add a link, go to **Drainage>Component>Link>Add**. Select a link name as stored in the **Preferences** for the prefixes shown below (the numbering will be auto-sequenced):



New Pipe	**NP**
Relay Pipe	**RP**
Existing Pipe	**EP**
New Ditch	**ND**
Existing Ditch	**ED**

V.F.1. Definition

Set the Link Definition option as shown below (Description field is optional):



1	From Node	Select the *Up*stream **Node**
2	To Node	Select the *Down*stream **Node**
3	Length	The length is automatically displayed as the distance between the From and To Nodes
4	Shape/ Material	Set the Shape to "Circular" and the Material to the appropriate type from the **Drainage Library** (see **note** below).
5	Design Size	Toggle ON for new pipe (NP); or toggle OFF for existing pipe (EP or RP) and click **Select** to pick the size from the **Drainage Library**
6	Design Barrels	Toggle OFF for new pipe (NP) and set to 1; and OFF for existing pipe (EP or RP) and set to the number of existing barrels.
7	Override Library PayItem	If your link is an existing pipe (EP) then check the box beside **Override Library Payitem** and type **714EP** in the space provided. This will prevent the Roadway Designer from overriding the existing pipe line style with the new pipe line style.

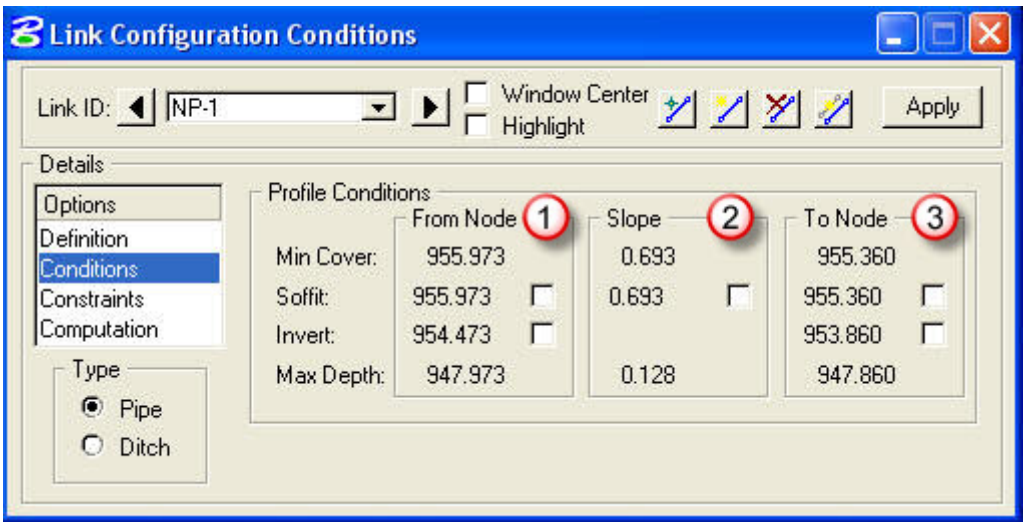
*Note: Refer to SCDOT Standard Drawings for fill height limitations for specified pipe. Where possible, keep pipe between the minimum and maximum fill height appropriate for each material. Keeping cover over pipe between 3’ and 10’ for most installations will allow one of each alternate pipe available to the contractor.

Pipe Type	Standard Drawing #
RCP	714-205-01, 714-205-02
SRAP	714-605-01, 714-605-02
HDPE	714-705-01, 714-705-02
CAAP	714-810-01, 714-810-02

Work with road designer when establishing pipe depth, particularly when pipe will be very shallow (<3' cover) or very deep (>10' cover). Shallow pipe may also present complications with drainage structures (see section V.D.4). Road designer will determine required class, gage, or type based on fill heights listed in SCDOT Standard Drawings.

V.F.2. Conditions

Set the Conditions of the link (for the **initial** design only, ***do not*** hold any of the conditions. If you use existing pipes, then they will need to be held):

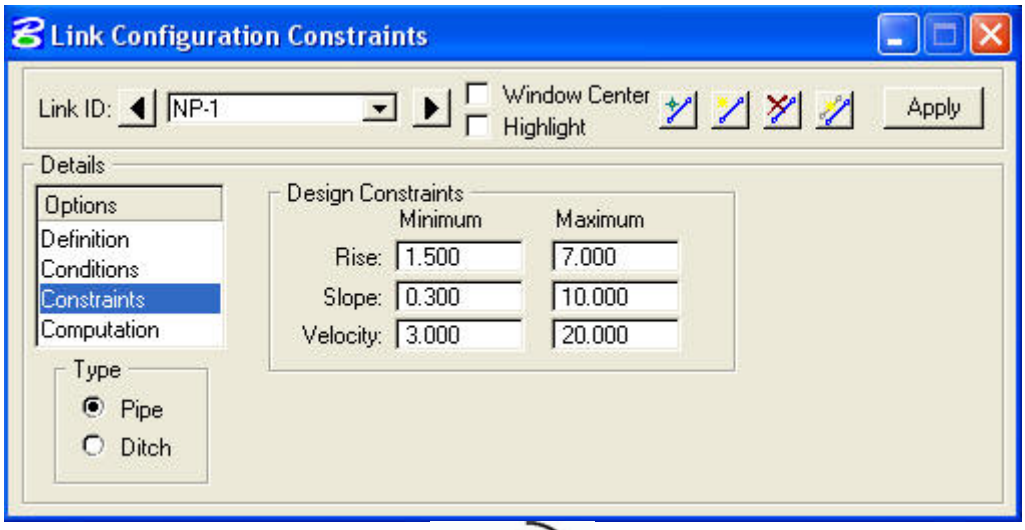


1	From Node	After the initial **design**, and only if necessary, toggle ON to set and hold the Invert or Soffit of the pipe, it is **better** to hold the Soffit and **do not** hold both.
2	Slope	After the initial **design**, and only if necessary, toggle ON to set and hold the pipe slope.
3	To Node	After the initial **design**, and only if necessary, toggle ON to set and hold the Invert or Soffit of the pipe, it is **better** to hold the Soffit and **do not** hold both.

The values for **Min Cover** and **Max Depth** come from the **Node** elevations.
You can also make adjustments through the **Profile** window.
Use this window to define the downstream outlet pipe elevation; as discussed in **Special Discussions**.

V.F.3. Constraints

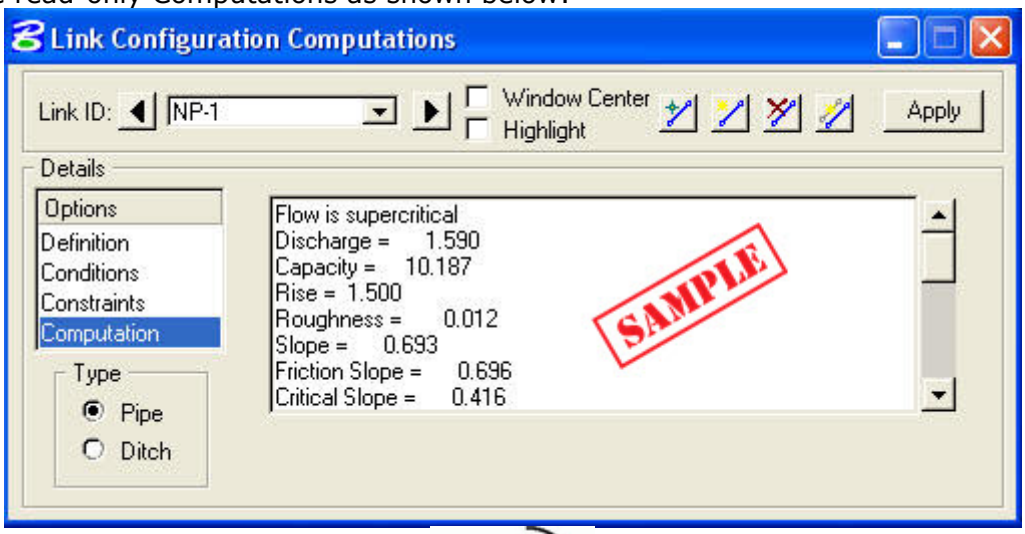
Set the link Constraints (**use** the values shown below for English units):



These values should **always** be used for the initial design; you may have to change the minimum slope or min/max pipe sizes later, but ***only*** for projects with design exceptions.

V.F.4. Computation

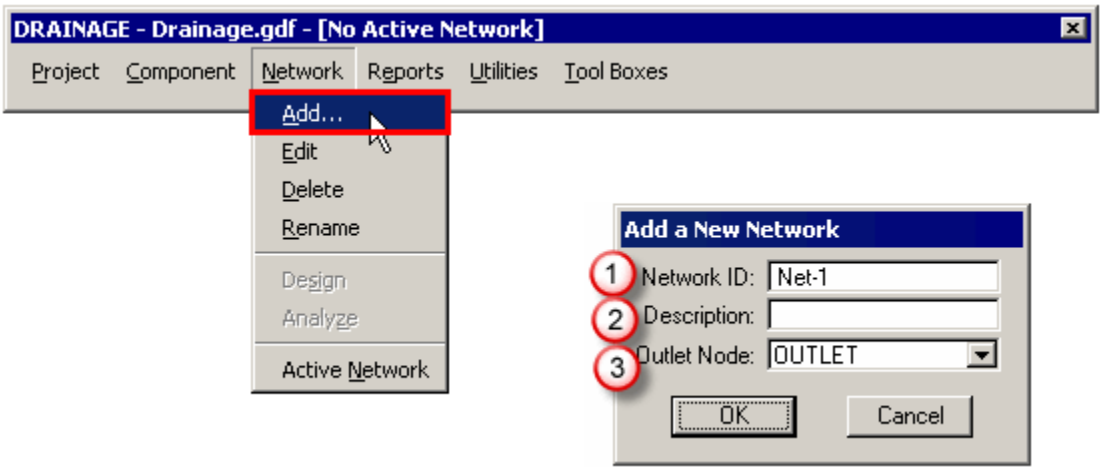
View the read-only Computations as shown below:



After you add the **network**, and then perform a **design**, computations and **errors** for this individual pipe appear in this window.

V.G. Networks

The network includes all **areas**, **nodes** and **links** connected to the **outlet node**. GEOPAK Drainage can handle any number of networks in one **GDF file**.
To add a network select **Drainage>Network>Add**.

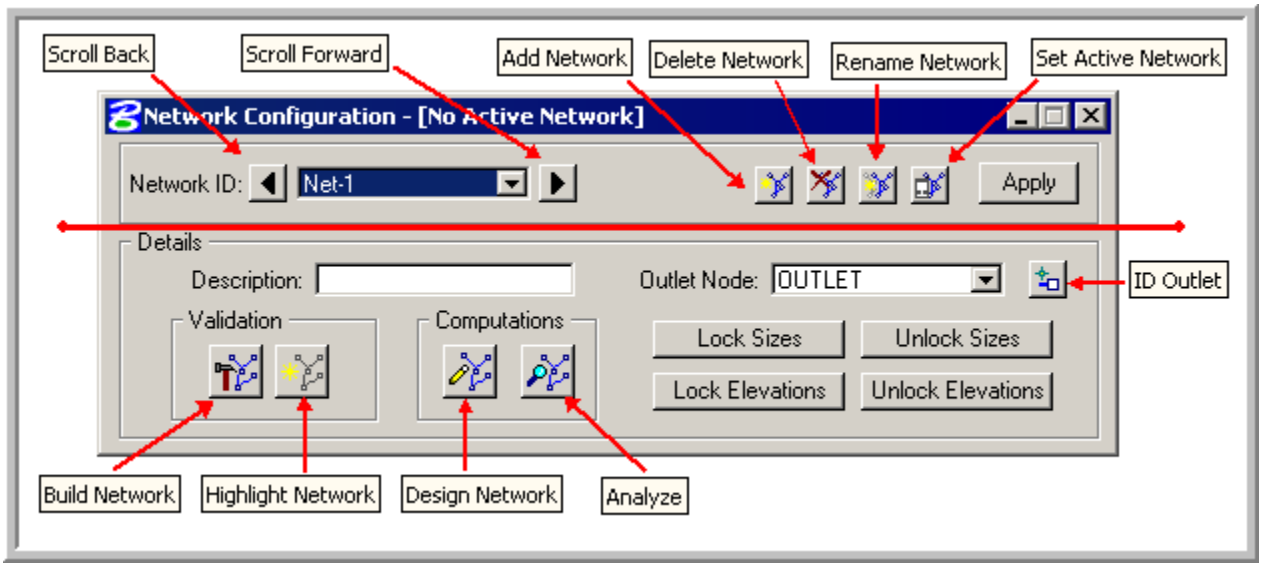


1	Network ID	Name the network by the station of the outfall.
2	Description	If there are multiple roads on a project put the road name in the description that matches the outfall station.
3	Outlet Node	Select the **Outlet Node** connected to the rest of the components contributing flow to this outlet.
Click **OK** to add the Network to the **GDF File**, else **Cancel**.		

If changes are made to the components the network will need to be **redesigned** or **reanalyzed**.

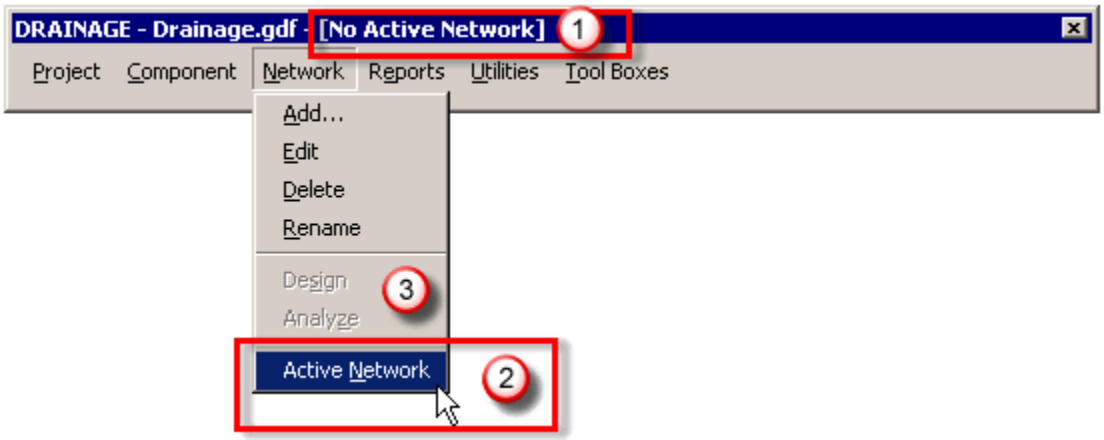
V.G.1. The network dialog

The Network Configuration dialog is split as shown below; top half for navigating and bottom half (Details) for input of data and computations:



V.G.2. Activating Networks

A Network should be activated prior to a **Design** or **Analysis**; select *Network* > *Active Network*:



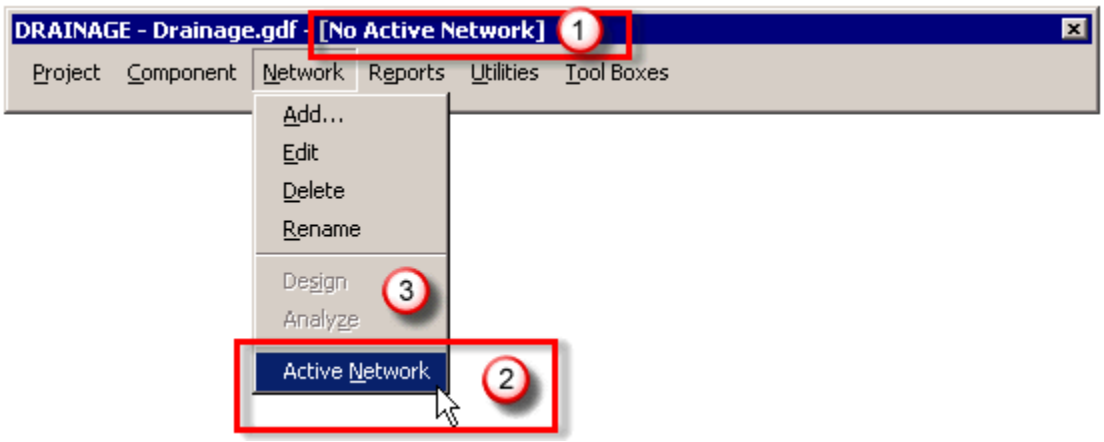
1	Active Network Indicator	This field will display the Active Network
2	Active Network	Select a Network to make Active
3	Design/Analyze	See **Design** or **Analyze**

V.G.3. Designing Networks

Designing a Network computes the hydrologic and hydraulic parameters of the Network, and ***automatically sets*** any unheld **node** or **link** elevations.

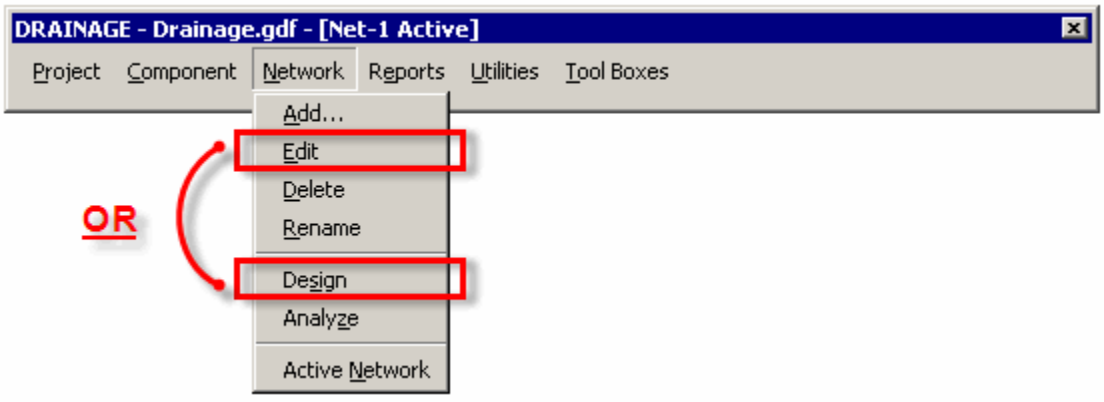
There are two (2) methods to Design a Network:

Method 1. From the main menu bar, select *Network* > *Active Network*:

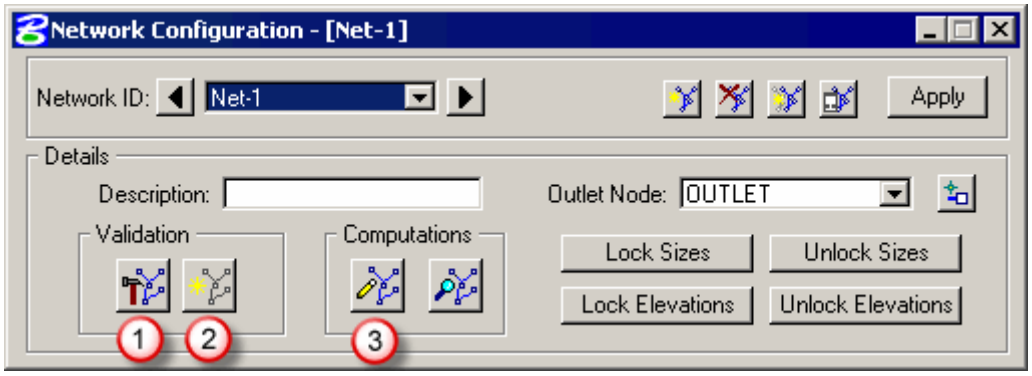


1	Active Network Indicator	This field will display the Active Network
2	Active Network	Select the Active Network on which to perform the design.
3	Design	Click to Design the activated network.

Method 2. Select Network>Edit:

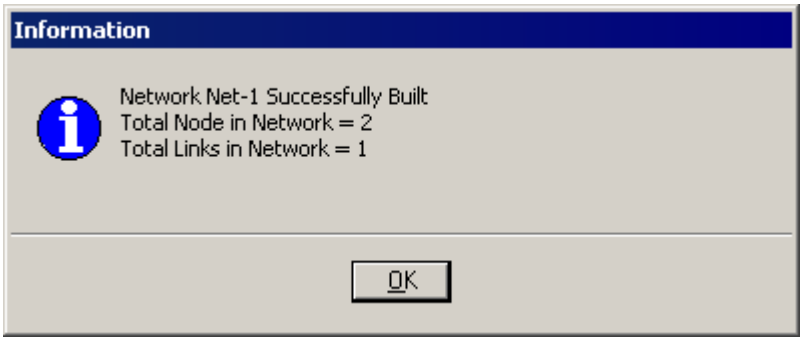


Use the workflow below:



1	Build Network	Click **Build Network** to build the component connectivity contributing flow to the Outlet Node

A "Successfully Built" message should ensue, otherwise see the **errors** section.



2	Highlight Network	*(Optional)* Click **Highlight Network** to MicroStation-highlight all the components contributing flow to the Outlet Node.
3	Design Network	Click **Design Network** to design the components of the **GDF project**.

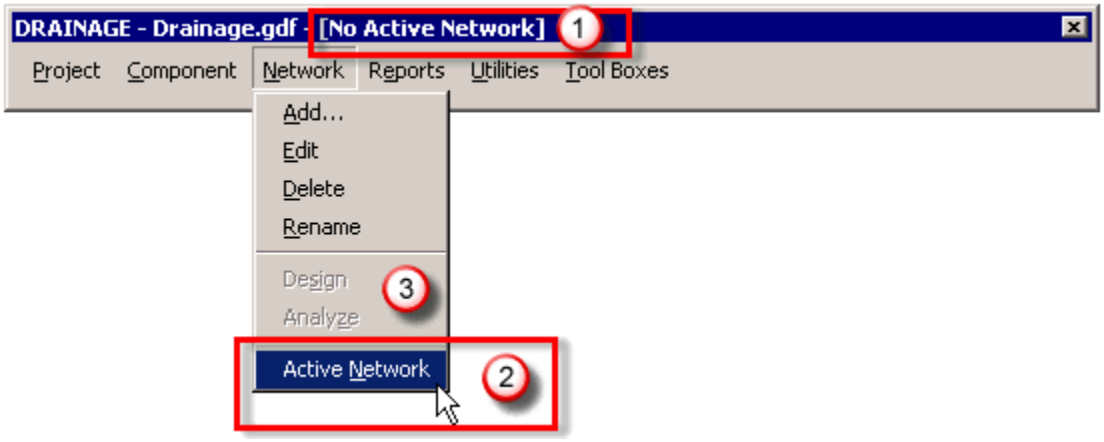
A "Successfully Computed" message should ensue, otherwise see the **errors** section. Drainage Warning/Error messages are reported for all components in the **GDF project** and are stored in the drgmsg.txt file in the **Working Directory**.

V.G.4. Analyzing Networks

Analyzing a Network computes the hydrologic and hydraulic parameters of the Network, but does ***not*** set any unheld **node** or **link** elevations and is useful for determining effects of various **storm events** on existing networks.

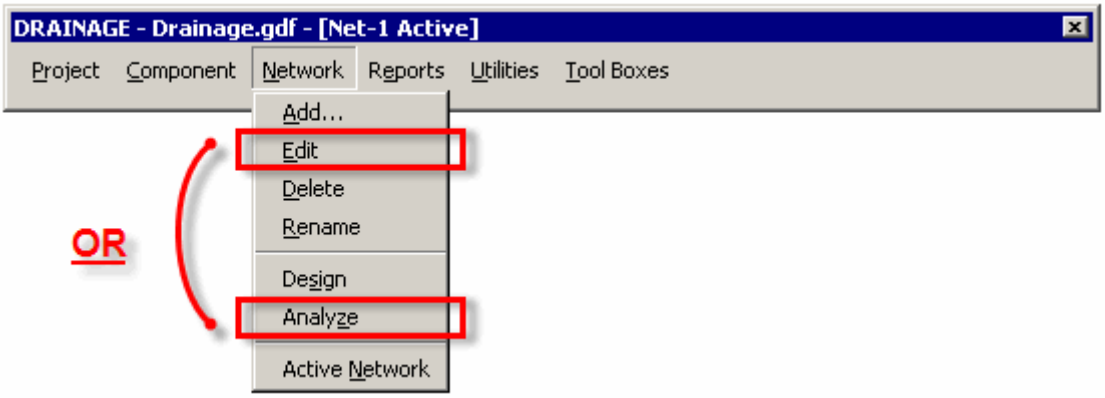
There are two (2) methods to Analyze a Network:

Method 1. From the main menu bar, select *Network > Active Network:*

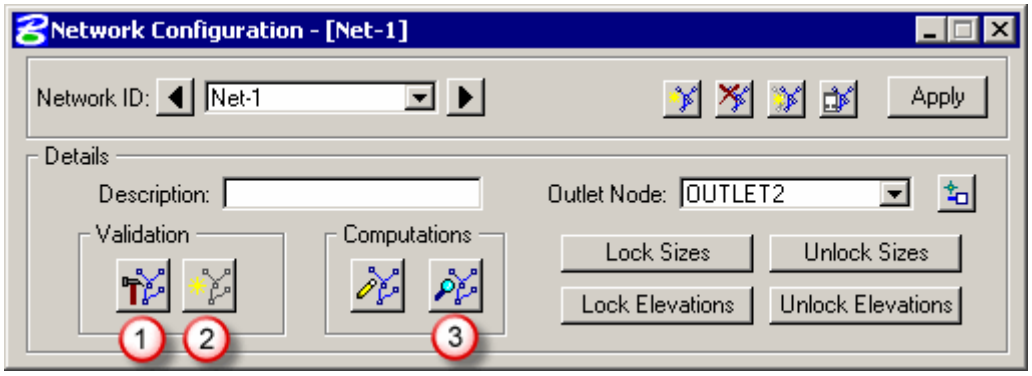


1	Active Network Indicator	This field will display the Active Network
2	Active Network	Select the Active Network on which to perform the design.
3	Analyze	Click to Analyze the activated network.

Method 2. Select Network > Edit:

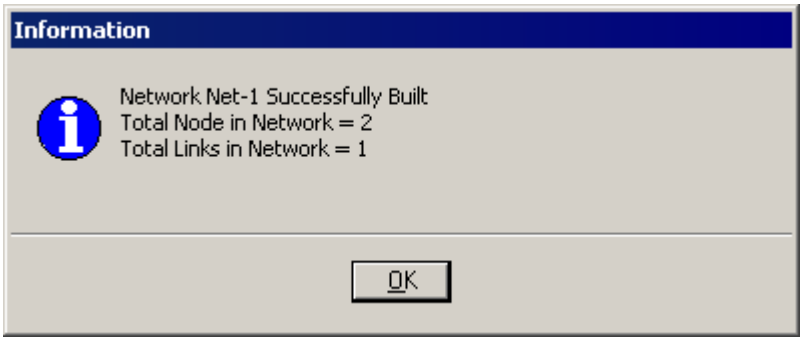


Follow the workflow below:



1	Build Network	Click **Build Network** to build the component connectivity contributing flow to the Outlet Node

A "Successfully Built" message should ensue, otherwise see the **errors** section.



2	Highlight Network	*(Optional)* Click **Highlight Network** to MicroStation-highlight all the components contributing flow to the Outlet Node
3	Analyze Network	Click **Analyze Network** to analyze the components of the **GDF project**

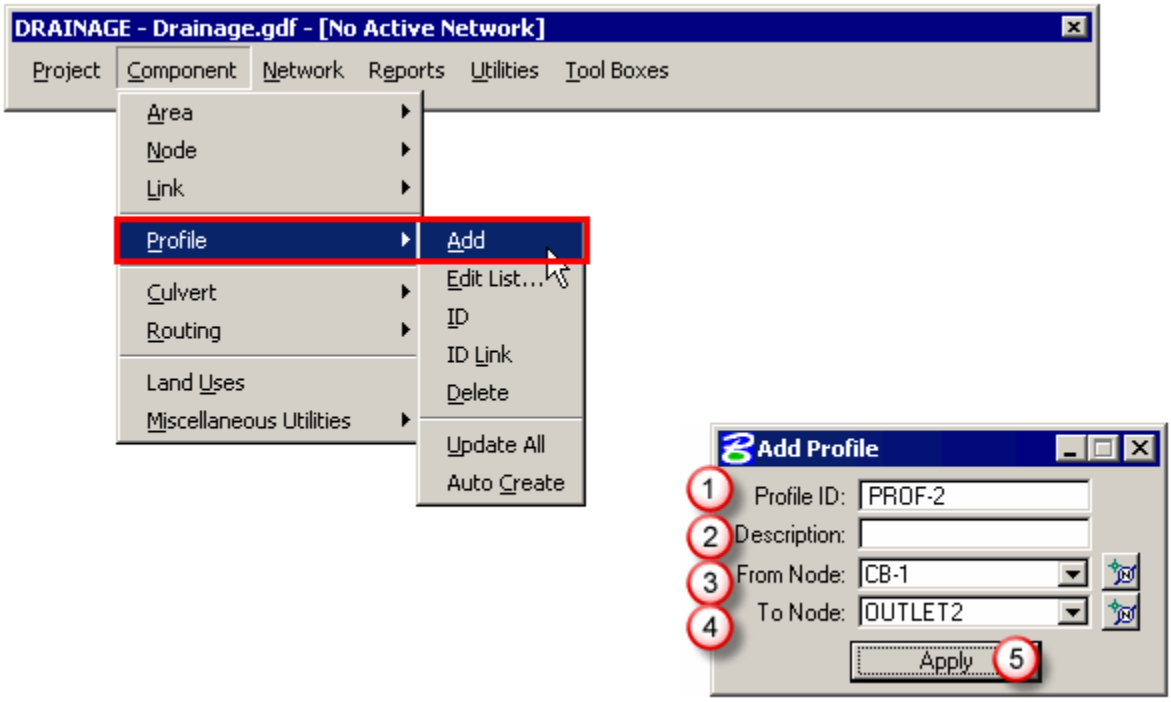
A "Successfully Computed" message should ensue, otherwise see the **errors** section. Drainage Warning/Error messages are reported for all components in the **GDF project** and are stored in the drgmsg.txt file in the **Working Directory**.

V.H. Profiles

GEOPAK Drainage can draw the entire profile of a storm sewer very quickly and is an easy way to determine if you are surcharging **nodes**.

Remember this information is used for evaluation purposes of our storm sewers and ***is not*** the information that the Roadway Designer will be expected to read.

To add and draw a profile select **Drainage>Component>Profile>Add**:



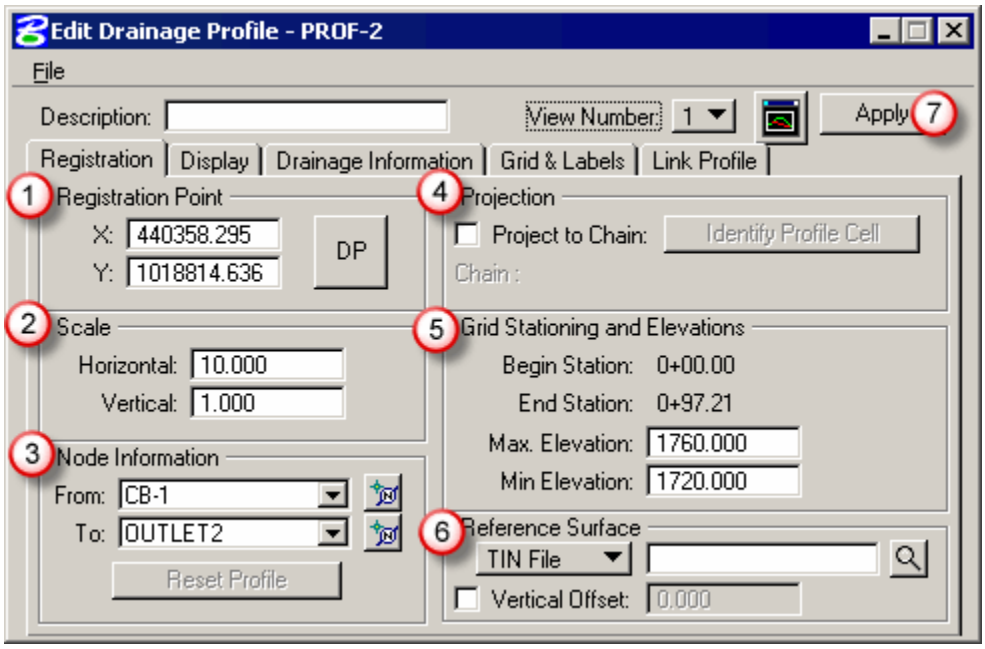
1	Profile ID	Key-in the Profile name (best not to use spaces)
2	Description	*(Optional)*
3	From Node	Most left Node on grid, and 0+00 station.
4	To Node	Most right Node on grid, and last station.
5	Click Apply to add the Profile.	

A profile is for a single run of **pipe** inbetween any two connected **nodes**. You ***cannot*** draw a profile for parallel pipes at once; therefore, draw multiple profiles for a storm sewer system with dual trunk lines.

As the profile is drawn to scale, you can measure distances inbetween lines. These profiles can also be printed through IPLOT.

V.H.1. Registration

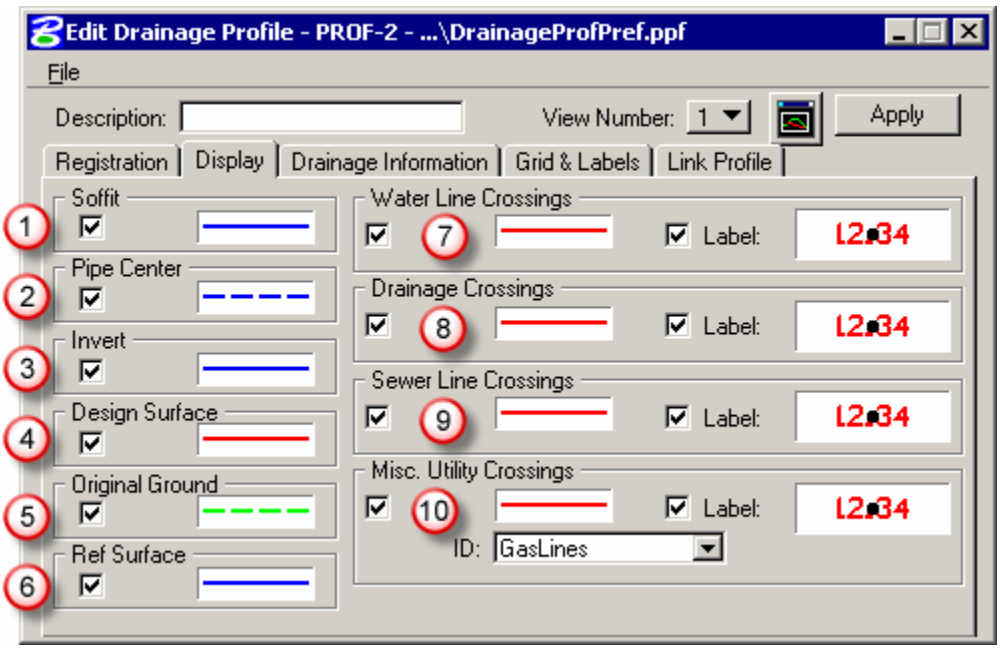
The Registration Point determines the location, scale and elevation of the profile:



1	Registration Point	Draw a line in the DGN, then click **DP** and click the end of the line; this will be the lower left point (X,Y) on the grid.
2	Scale	Set the Horizontal & Vertical Scale.
3	Node Information	**From Node** = left-hand on grid and **0+00** station; **To Node** = right-hand on grid and ending station (see bullet #5 below)
4	Projection	n/a
5	Stations& Elevations	Stationing is *read-only*.
6	Reference Surface	n/a
7	Click Apply to draw the profile in the DGN file.	

V.H.2. Display

Set the Profile's display. Make sure they are all on Level RD_HY_Gpkprofile, but choose whatever color and weight you want.

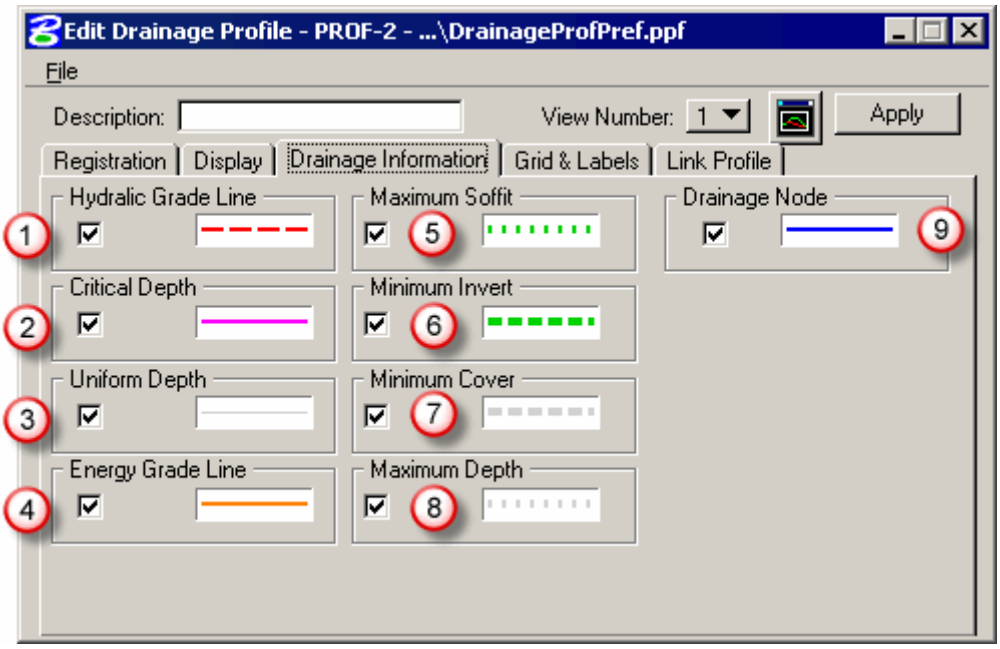


1	Soffit	Top of Pipe
2	Pipe Center	Center of Pipe
3	Invert	Bottom of Pipe (flowline)
4	Design Surface	Proposed Finished Grade (TIN or Model) located in the **Preferences**
5	Original Ground	Existing Ground (TIN or Model) located in the **Preferences**
6	Ref Surface	(Optional) 3rd surface from the **Registration Tab**
7	Water Line Crossings	n/a
8	Drainage Crossings	Toggle ON to show the drainage crossings
9	Sewer Line Crossings	n/a
10	Misc Utility Crossings	n/a

Click Apply to modify the Profile.

V.H.3. Drainage Information

Select the drainage information to be displayed in the profile view. Make sure they are all on Level RD_HY_Gpkprofile but choose whatever color and weight you want.



1	Hydraulic Grade Line	Auto-generated Hydraulic Grade Line
2	Critical Depth	Auto-generated Critical Depth
3	Uniform Depth	Auto-generated Uniform Depth
4	Energy Grade Line	Auto-generated Energy Grade Line
5	Maximum Soffit	Maximum elevation of top of pipe
6	Minimum Invert	Minimum elevation of bottom of pipe
7	Minimum Cover	Minimum cover on top of pipe
8	Maximum Depth	Maximum depth of bottom of pipe
9	Drainage Node	Node display symbology in profile view

Click Apply to modify the Profile.

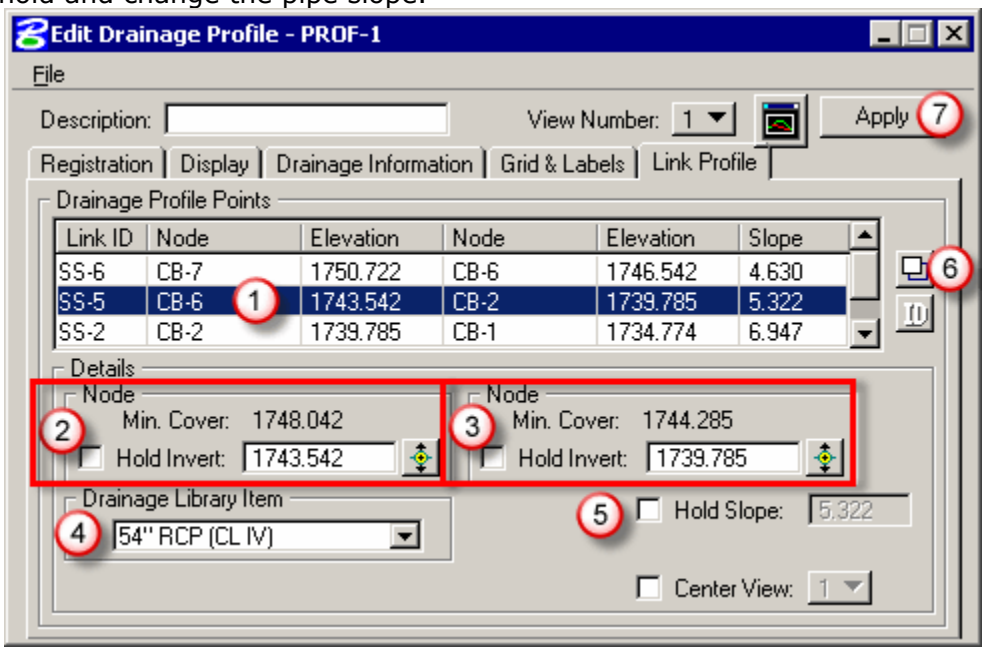
V.H.4. Grids & Labels

Set each option on an individual basis.

Pick from the options and choose whatever looks best to you. You can easily clutter the

V.H.5. Link Profile

This is a powerful tool allowing you to modify the pipe invert elevations and slopes. In the top portion you will see all the pipes in the profile. Highlight a pipe and its invert elevations appear under Details>Node. From there you can manually change the invert and hold it or you can click the Edit Invert button and move the invert on the profile. You also have the option to hold and change the pipe slope.



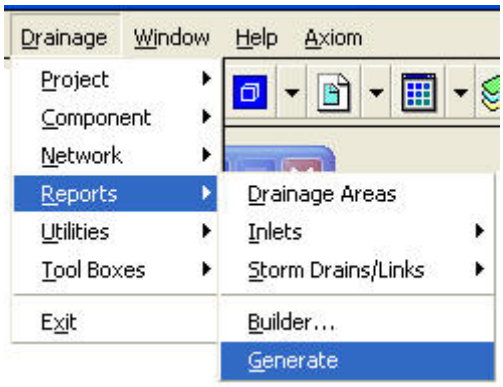
1	Link ID	Highlight the Link ID in the list
2	Node	Use the button to dynamically adjust the vertical invert in profile view; or key-in the "Hold Invert" elevation then toggle ON "Hold

		Invert".
3	Node	Use the  button to dynamically adjust the vertical invert in profile view; or key-in the "Hold Invert" elevation then toggle ON "Hold Invert".
4	Drainage Library Item	n/a
5	Hold Slope	Toggle ON and key-in a slope value.
6	Modify	Click the  Modify button to change the Link.
7	Click  to accept the revision, redesign the Network, and redraw the Profile.	

If a change is made, the **Network** should be **redesigned** or **reanalyzed**.

V.I. Reports

Under the Drainage>Reports menu, the three top options are summary reports that GEOPAK Drainage automatically generates. To print these reports you must open one of the three reports, press Alt-Print Scrn, then open Paint and press Ctrl V or open Microsoft Photo Editor and choose Edit>Paste as New Image. You can print directly from either program. To generate a specific report you must open the **Report Builder…** This is where you can generate custom reports for system evaluation.



V.I.1. Standard Interoffice

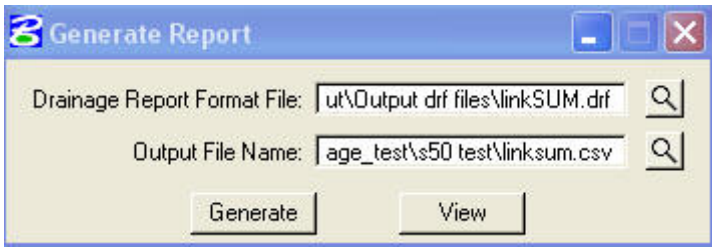
The information for our standard interoffice reports and Roadway Designer reports has been preset in a set of **DRF files** found on **Standard Files_Geopak/GEOPAK Output/Output** drf files. The .drf files were developed under Builder… and the information contained in them is listed in **Appendix A**.

To create our final standard interoffice reports is no simple task. Basically you must generate a set of **CSV files** from a set of **DRF files**, and then paste the information in the .csv files in a .xls file for the final report. In the end, you will only have five .xls files for the whole project regardless of the number of storm sewers you design.

V.I.2. Generate

To utilize the **DRF files** select **Drainage>Reports>Generate**. Make sure you have an active network selected. By **Drainage Report Format File** choose a preset .drf file from the directory listed in the **Standard Interoffice Reports** section - nodestandard.drf, linkstandard.drf, areastandard.drf, nodestandardroad.drf, linkstandardroad.drf, nodesum.drf, linksum.drf.

By **Output File Name** choose your working directory and name the file whatever you desire, but change the extension to csv. Select **Generate** and you will receive a message stating the file has been generated.



Linksum.csv and nodesum.csv will only need to be generated once, and it does not matter which storm sewer is active since these files are not storm sewer specific. You must generate the remaining five **CSV files** for every network (storm sewer system) you designed. These files are specific to each particular storm sewer.

V.I.3. Final Reports

Download our standard output XLS files from **Standard Files_Geopak/GEOPAK Output/Blank Files** to your project directory. The **CSV files** (linksum.csv and nodesum.csv) will be pasted in the linkstandardroad.xls and nodestandardroad.xls, respectively. We will discuss this in the next section. Now we will discuss the storm sewer specific files. The storm sewer specific files are the **CSV files** you created from the **DRF files** (nodestandardroad.drf, linkstandardroad.drf, nodestandard.drf, linkstandard.drf, and areastandard.drf.) You should have five .csv files for each storm sewer. The following is the process for creating our standard output files, for the individual storm sewers, from the **CSV files**.

1. Open the appropriate .xls file for the .csv file that you already have open– nodestandard.xls, linkstandard.xls, areastandard.xls, nodestandardroad.xls, linkstandardroad.xls. You will alter this file to reflect your information.
2. Add headings to the first sheet in rows 1 and 2. View the files under J:/Standard Files/GEOPAK Output/Sample output to see exactly how the reports should look.
3. Select **Edit>Move or Copy Sheet…** and copy as many sheets as you have networks/storm sewer systems.
4. Change the sheet name to match the network name, i.e. System 12+00. Each sheet within the workbook will represent one system.
5. Highlight the data in the .csv file.
6. Right click and select **Copy**.
7. Go to the standard file (.xls) you just modified. Activate the appropriate sheet for the .csv file you are copying.
8. Click on the first cell under the table heading in the A column.
9. Right click and select **Paste Special…**
10. Choose **Values**
11. Choose **OK**. The font and alignment should be automatically set.

The files with road at the end (linkstandardroad.xls and nodestandardroad.xls) are to be sent to Roadway Designer. The other files are for your in-house report. Be sure to check that the max Design Capacity of 94% has not been violated. Eventually we will add a line in the report to give you such information.

Summary Report Files

We need to paste the linksum.csv and nodesum.csv files into the linkstandardroad.xls and nodestandardroad.xls files, respectively.

1. Open one of the sum.csv files.
2. Go to **Data>Sort…**.
3. Click the down arrow under **Sort by** and choose **Item**.
4. Choose **OK**.
5. Open the appropriate .xls for the appropriate sum.csv file you have open.
6. Select the sheet labeled Summary Report.
7. Add headings to the first two rows. View the files under J:/Standard Files/GEOPAK Output/Sample output to see exactly how the reports should look.
8. Highlight the data in the .csv file.
9. Right Click and select **Copy**.

10. Go to the standard file (.xls) you just modified. Activate the Summary Report sheet for the .csv file you are copying.
12. Click on the first cell under the table heading in the A column.
13. Right click and select **Paste Special…**
14. Choose **Values**
15. Choose **OK**. The font and alignment should be automatically set.

Lastly, we need to run a macro to sum the pipes and basins. Two summary tables will be generated, one in the nodestandardroad.xls and one in the linkstandardroad.xls.

1. Open either nodstandardroad.xls or linkstandardroad.xls and activate the Summary Report sheet.
2. Open J:/Standard Files/macros/drainage_report.xls. This is the macro file.
3. A message box will appear. Choose **Enable Macros**. It will appear as if nothing has happened.
4. Go to **Tools>Macro>Macros…**.
5. Choose **drainage_report.xls!Link_cal.Link_cal** if you are in linkstandardroad.xls and **drainage_report.xls!Node_cal.Node_cal** if you are in nodestandardroad.xls.
6. Choose **Run**.
7. You will get two messages. Click **OK** for both. The summary table will appear just below your inputted data.
8. Repeat these steps to generate the other summary table.

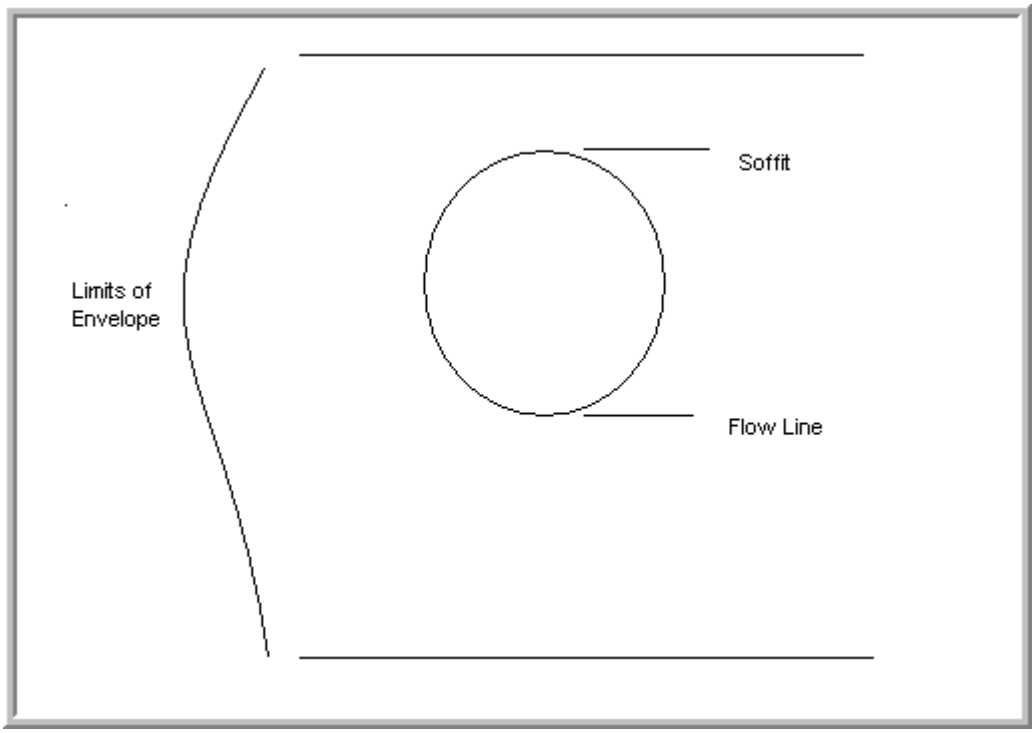
VI. Special Discussions

The following are special discussions:

1. Outlet Definition
2. COGO
3. Navigator
4. Converting V7 to V8

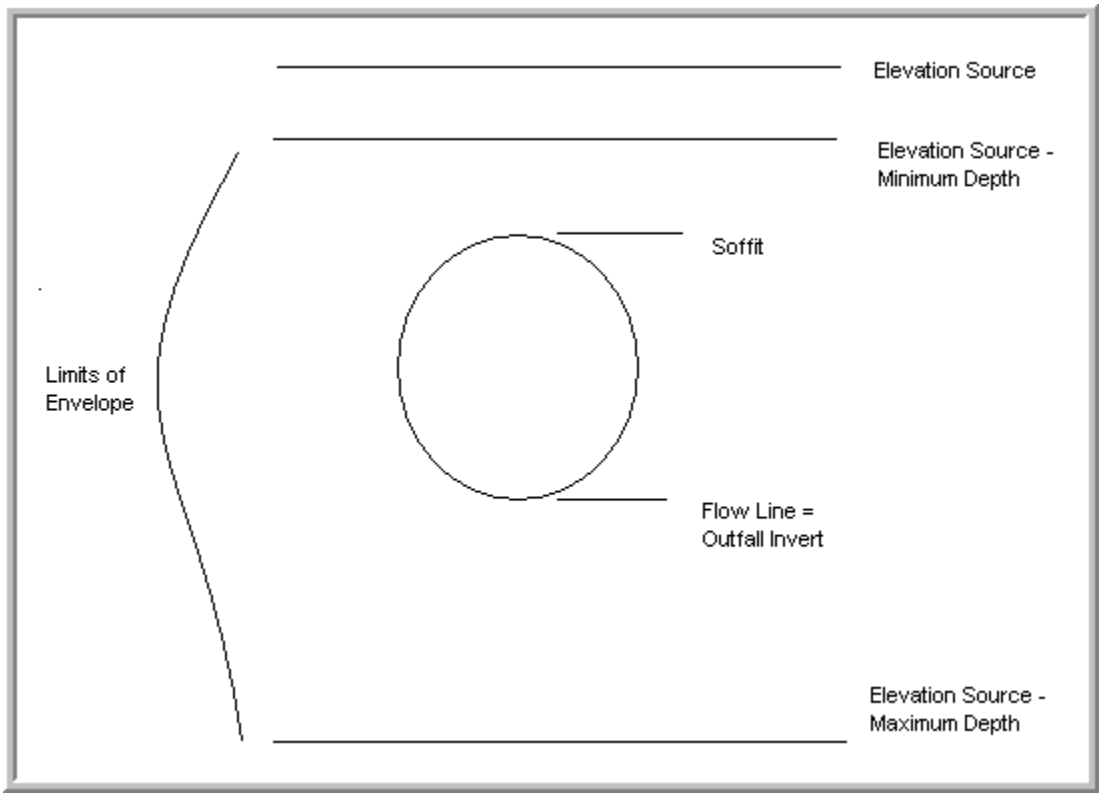
VI.A. Outlet Definition

Several references have been made to defining the outlet in this document. The outlet is the only node where you have a set elevation that you must match. You want the pipe invert equal to the outfall invert. Below is the full explanation on how to do this. GEOPAK Drainage wants an envelope defined for every node. This envelope is a vertical range that Drainage can use to place the pipe:



The **pipe**, regardless of its size, will fit within these limits that you set. Each **node** has an envelope, but the outlet envelope is much harder to define.

In the **node** box under **Elevation**, the **Elevation Source** and **Minimum / Maximum Depth** defines the envelope (Figure 2). The program takes the **Elevation Source** and subtracts the **Minimum Depth**. This is the top of the envelope and the highest elevation that the soffit of the pipe can be located.

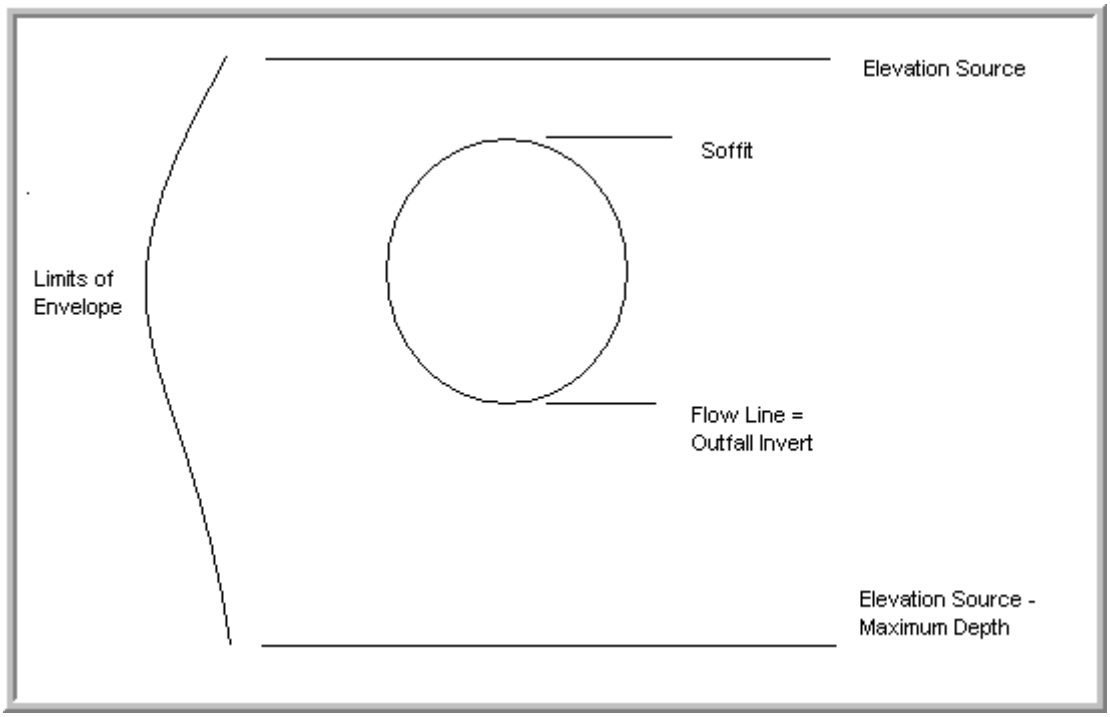


The program then takes the **Elevation Source** and subtracts the **Maximum Depth**. This is the bottom of the envelope and the lowest elevation that the flow line of the pipe can be located. This process is called building the envelope.

For all nodes but the outlet, the **Elevation Source** is easily defined as either the top of curb or ground elevation. The outlet, however, does not have a set elevation above the soffit. The pipe is out of the ground, and the ground elevation is at the bottom of the pipe. The top of the envelope has to be defined with an assumed elevation.

The following steps will aid you in building the envelope for the Outlet:

1. Open the Node window for the outlet.
2. Put 0.00 as the **Minimum Depth** in the **Node** window under **Elevations**. This means the program will not have to subtract anything to get the top of the envelope.
3. Put what you normally would for the **Maximum Depth**. This will define the bottom of the envelope. This will be below the known flow line elevation, but this will not cause a problem.



4. Assume an **Elevation Source**. Most of the time you have a good idea of the outlet pipe diameter by looking at the area draining to your system. If you have 800’ of road drainage, an 18" pipe will probably do. In this case you would add 1.5’ to the outfall invert or flow line and enter this as the **Elevation Source**.
5. Open the **Links** box for the last link of our system.
6. Take the elevation that you calculated for **Elevation Source** and enter that value as the downstream soffit elevation in the **Conditions** window.

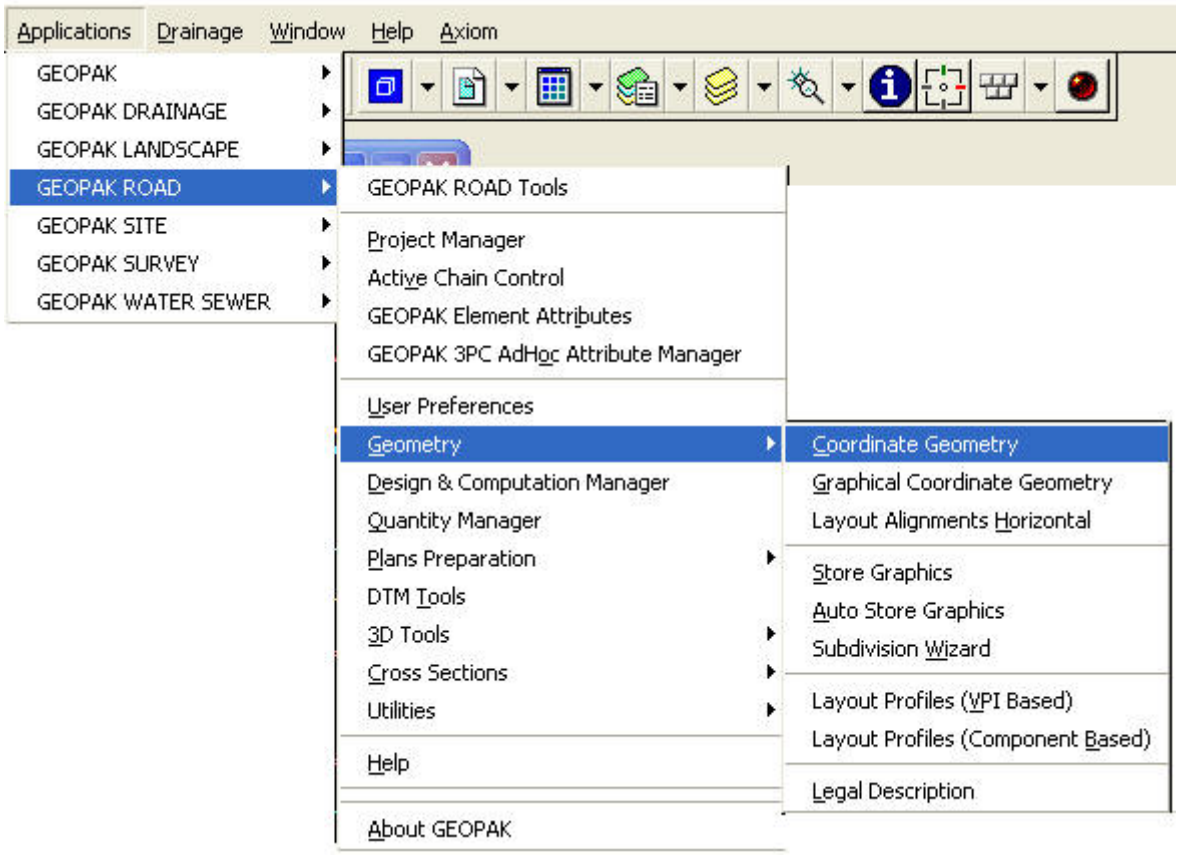
If you guessed a pipe size too large, then your pipe is not flush with your outfall invert. Go back to Links>Constraints and change the soffit elevation. If you guessed a 24" pipe and it designed 18", subtract 0.5’ from your original input.

If you guessed a pipe size too small, then your pipe invert is underground. Go back and change your Elevation Source under Node>Elevations. Use this value under Links>Constraints as your new soffit elevation. If you guessed an 18" pipe and it designed a 24", then add 0.5’ to your original input.

It is possible to have the limits of the envelope above and below the pipe with the pipe not coinciding with either limit.

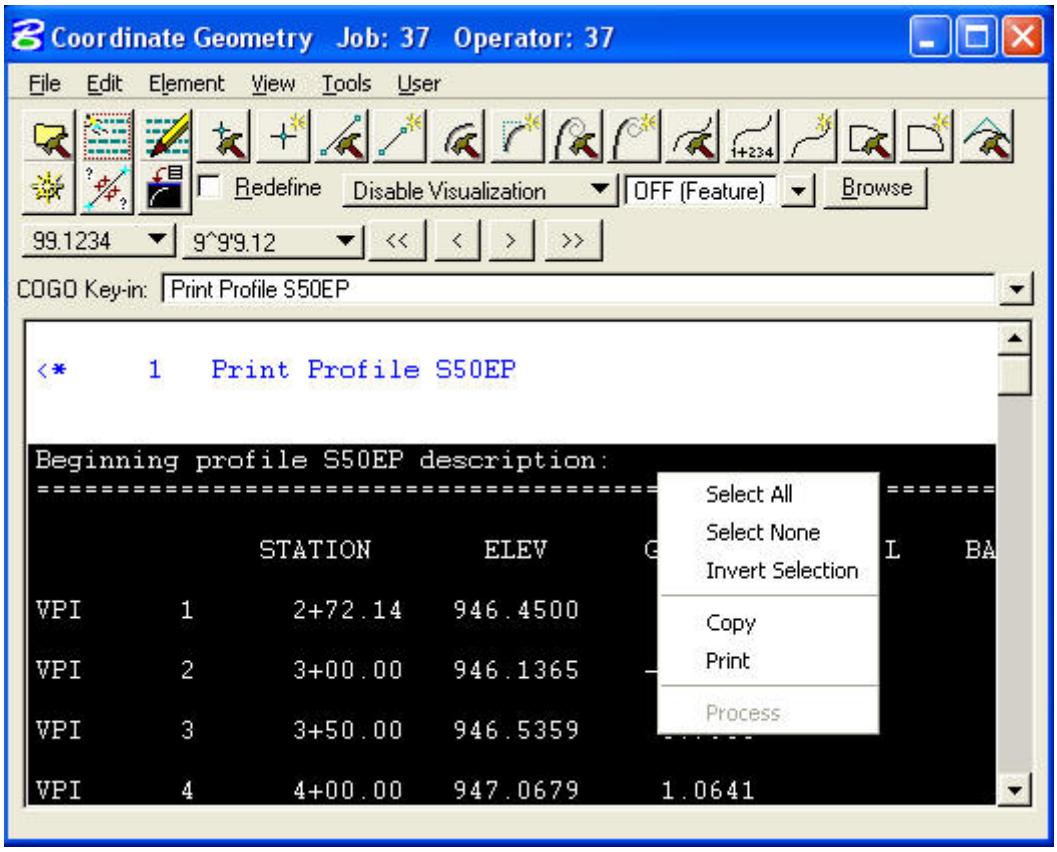
VI.B. COGO

In December 1998, we were advised to use COGO to locate high and low points on the centerline profile of the road. You can utilize this information to space your basins.



The program is under GEOPAK Road instead of GEOPAK Drainage. To open this go to **Applications>GEOPAK Road>Geometry>Coordinate Geometry**. In the Coordinate Geometry box choose the Magnifying Glass button by **Job Number** and select the **GPK file**. The **Operator Code** is the county number. Do not fill in the other boxes.

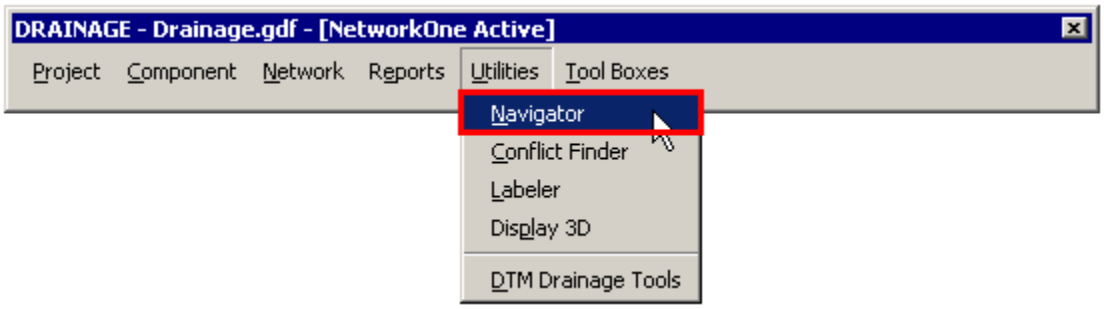
Open **Element>Profile>Utility**. Obtain the centerline profile and left and right top of curb profiles from the spreadsheet the Roadway Designer emailed, choose one from the list and select the **Print** button. The information will appear in the window. All low and high points for that profile will be marked accordingly. Repeat the process for the two remaining profiles.



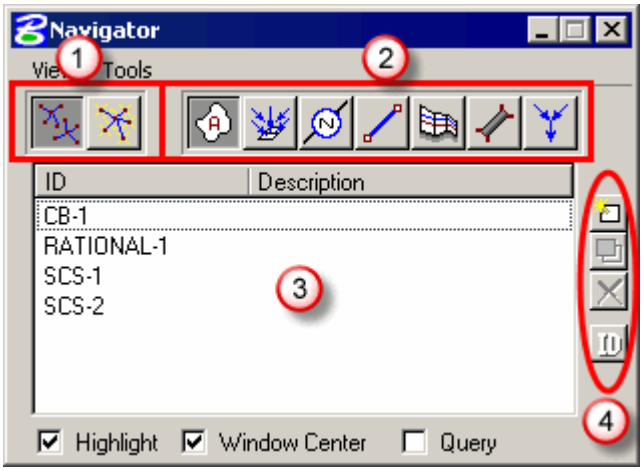
To print, highlight the data, then right click, then choose **Print**. The file will print directly to the printer.

VI.C. Navigator

The Navigator is a powerful tool to aid you in maneuvering through a project. You can also add, edit, delete and identify all drainage components from the Navigator:



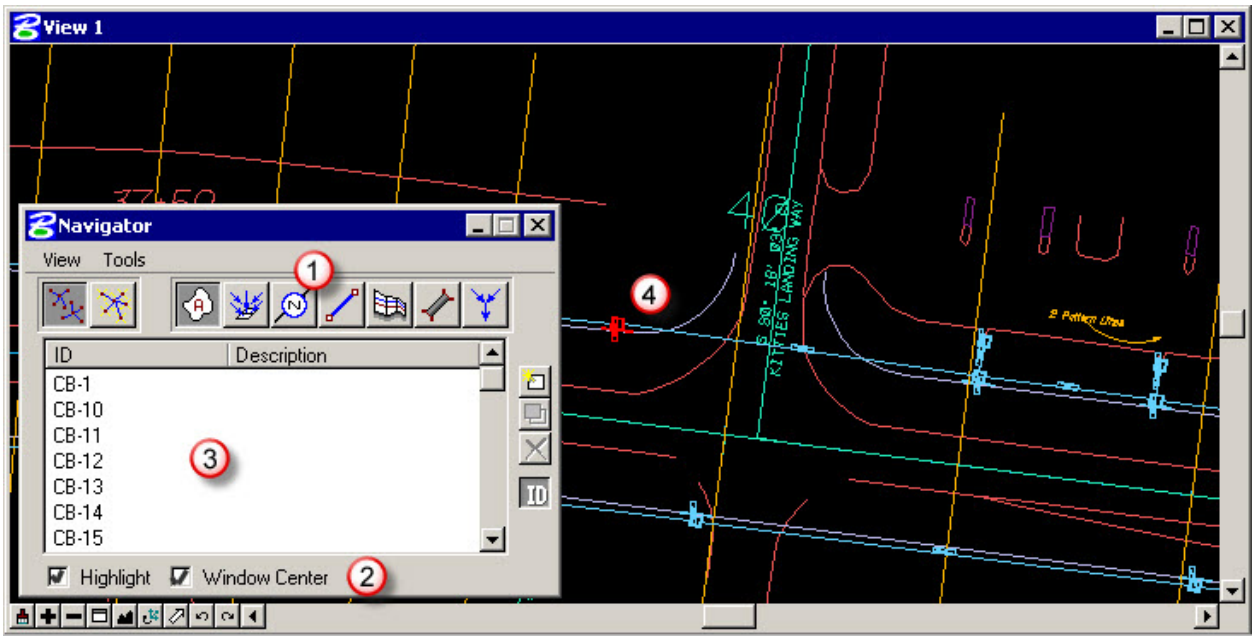
The Navigator has the following toolsets:



1	Networks	"All Networks" or only the "Active Network"
2	Components	Options include: Areas, Inlets, Nodes, Links, Profiles, Culverts and Routings, (displayed left to right)
3	ID List	The list of components available by the selection in bullet #2 above
4	Action Buttons	Click to add / modify / delete / or ID any component for modifications

VI.C.1 Navigating

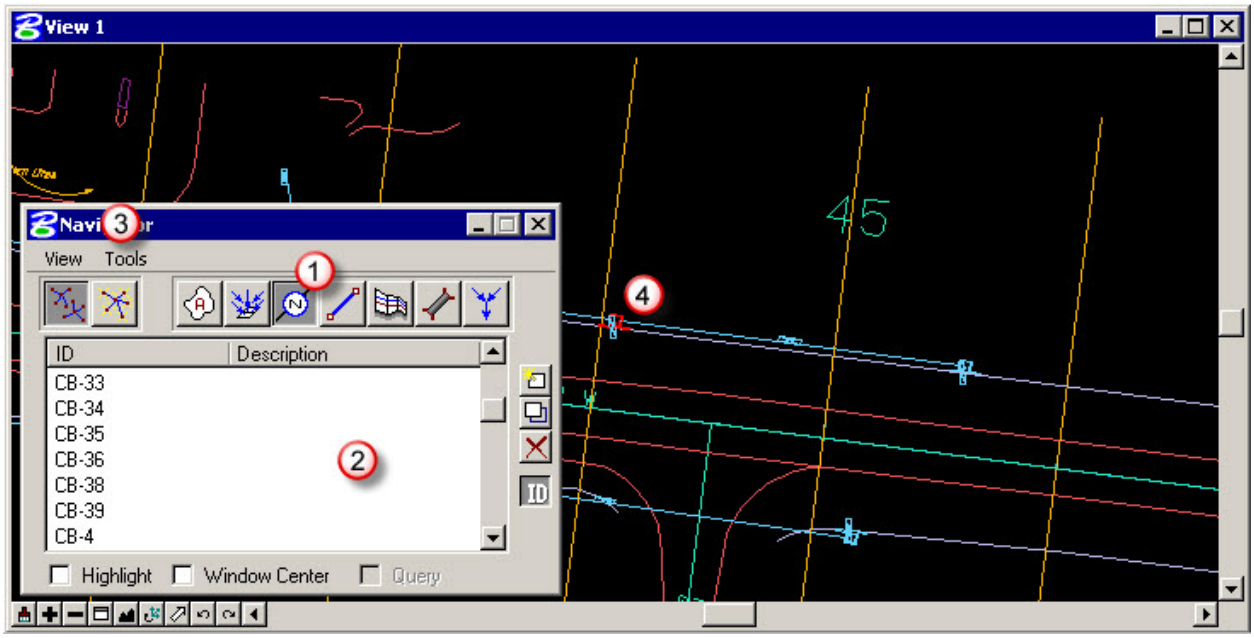
To navigate the components of the Drainage design, click the Play button and follow the steps in the video below:



1	Type	Select the **Nodes** or **Links** or any component type
2	Toggles	Toggle ON so the MicroStation view will "window center" and "highlight" on the drainage node or link
3	Component	Click any component in the list
4	View	The Microstation view updates to window center and highlight the selected drainage component
5	Repeat as necessary to navigate the components	

VI.C.2. Updating Graphics

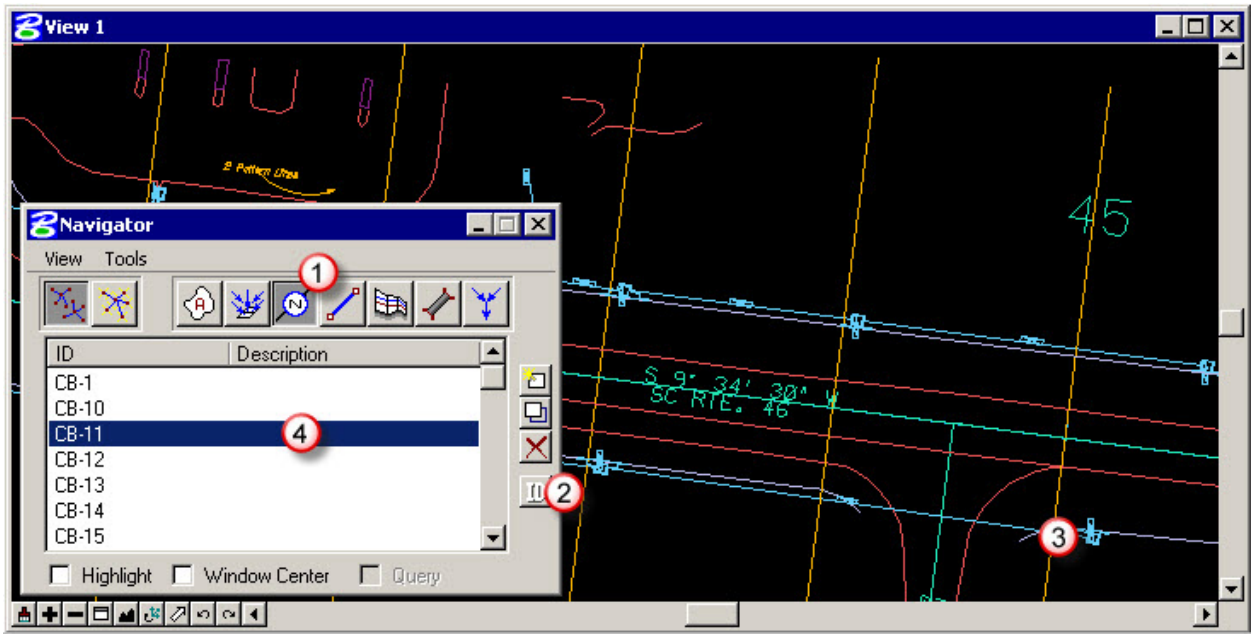
To update the Drainage graphics in the **PP.DGN** file, click the Play button and follow the steps in the video below:



1	Type	Select the **Nodes** or **Links** or any component type
2	Selection	Select all (or any you wish) components in the list for graphical updating
3	Tools	Select Tools > Update Graphics to commence the procedure
4	View	The Microstation view updates with the node or link graphics
5		Repeat as necessary to update the graphics on the components

VI.C.3. Identifying Items

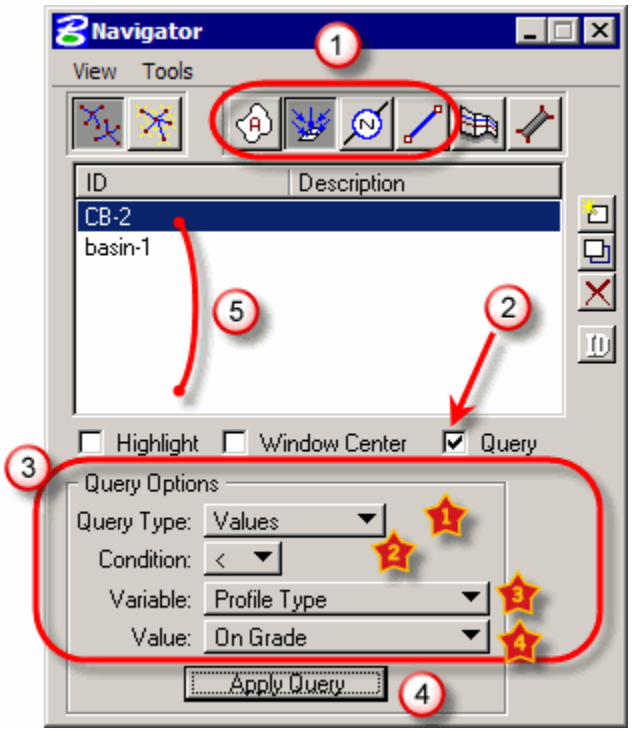
To identify a Drainage component in the **PP.DGN** file, click the Play button and follow the steps in the video below:



1	Type	Select the **Nodes** or **Links** or any component type
2	ID	Click the ID button
3	Select	Select any Node or Link in the DGN file
4	Navigator	Notice the specific Node or Link gets found and highlighted in the Navigator window
5	Repeat as necessary to identify the drainage components.	

VI.C.4. Query Mode

Use the workflow below to utilize the Query Mode:



1	**Select the Component Type**	
		Query Mode available for Areas
OR		Query Mode available for Inlets
OR		Query Mode available for Links

2	**Toggle ON "Query" mode**

3	**Query Options**	
1	Query: Values	A **Value** is usually one of two types: "alpha" (i.e. pipe material) or "numeric" (i.e. pipe slope).
OR	Query: Constraints	A **Constraint** is usually one of two types: "min" (i.e. minimum depth) or "maximum" (i.e. maximum depth).
2	>	Condition = "greater than"

OR	=	Condition = "equals"
OR	<	Condition = "less than"
3	Variable	If the Query Type is set to 'value', a variable may be available.
OR	Constraint	If the Query Type is set to 'constraint', a constraint may be available.
4	Value	Value mode is usually one of two types "alpha" (i.e. curb) or "numeric" (i.e. curb length)

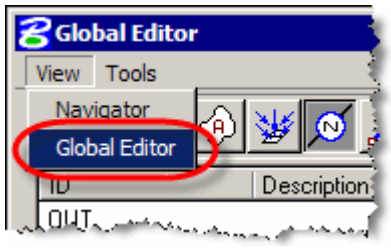
4	**Apply Query**	
	Apply Query	Click **Apply Query** to initiate the computations

5	**Navigator Window**	
	Query Applied	The components ***remaining*** in the Main Navigator Window meet the results of the applied Query.

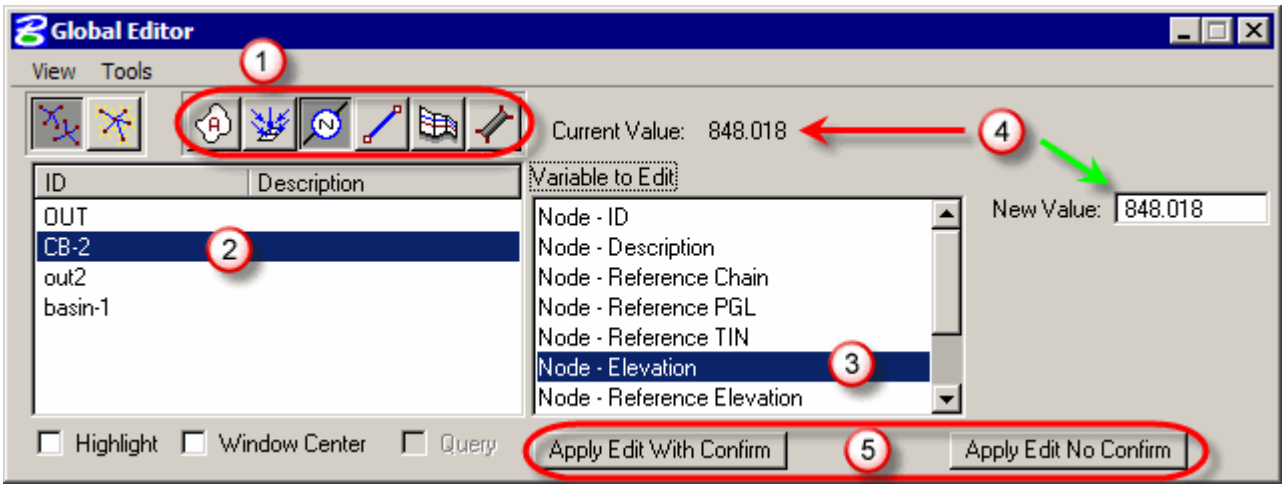
After a Query is applied, the Navigator Window will ***continue*** to display only the results of the Query, until it is reopened, or another Component Type is selected.

VI.C.5 Global Editor Mode

From the Navigator's pull-down menu, select Global Editor:



Use the workflow below for Globally Editing components:



1	Select the Component Type:	
	Components	Only **Areas**, **Inlets**, **Nodes** or **Links** are available for Global Edits.

2	Select the Component(s):	
	Keyboard Input	Highlight (use keyboard shortcuts) single, multiple, or all components on which to perform the Global Edit(s).

3	Variable to Edit	
	Variable to Edit	Select any one of the available **Variables** to Edit.

4	Current / New Value	
Current Value	Current Value	Displays the current value of the selected variable in the step above.
New Value	New Value: 849.983	**Key-in** the new value of the Variable.
Overwrite OR Find/Replace	Overwrite Text: New Text: existing.tin Find and Replace: Find Text: existing.tin Replace Text: proposed.tin	Either "Overwrite Text" with "New Text", **OR** Use "Find Text" / "Replace Text" feature.

5	Apply Edits	
	Apply Edit with Confirm	Click to make the changes without any confirmation warning messages.
OR	Apply Edit No Confirm	Click to make the changes with a confirmation warning message for ***each*** component selected in bullet #2 above.

Use the same workflow above (for any available variables) for Areas, Inlets, Nodes, or Links.

VI.D. Convert V7 to V8 or XM

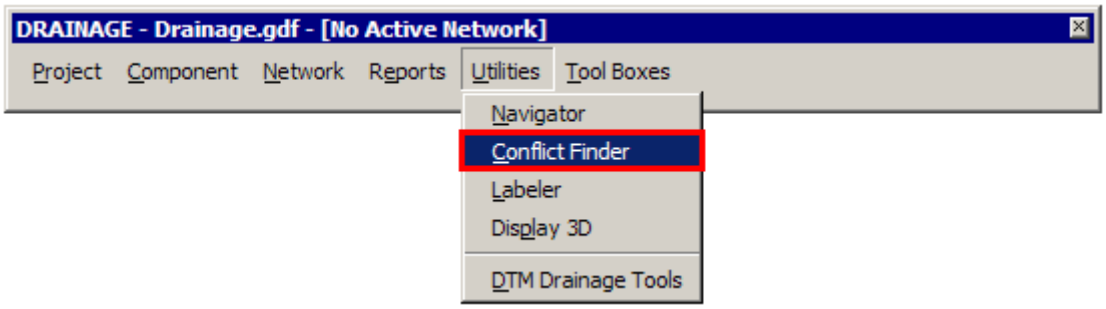
Before converting the existing files copy all V7 files into a separate project folder and name it "Copy of V7 files". The conversion should work seamlessly, but it doesn't hurt to have a copy of the original.

Follow these steps to convert the Drainage file from V7 to V8 or XM.

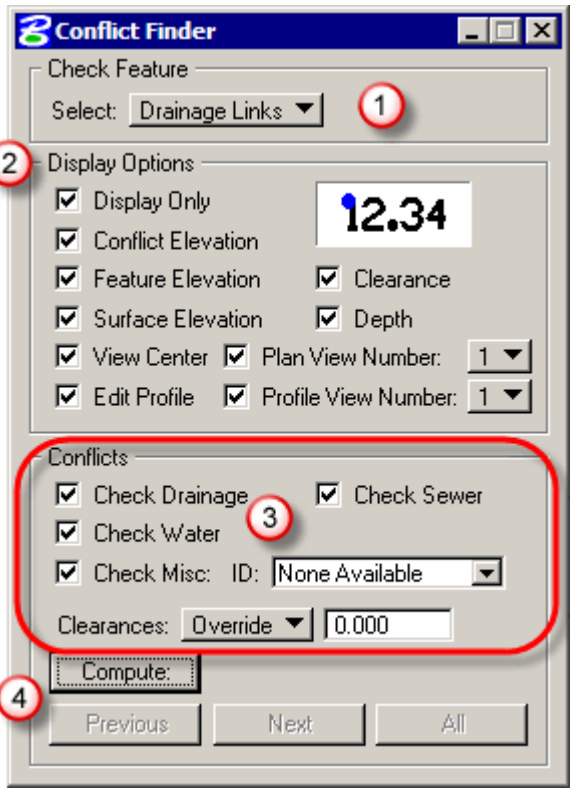
1. Place your **GDF File** and **HY.dgn** files in the project directory
2. Open the hy.dgn file using V8 and let it convert the file to V8
3. Turn off all levels except containing your **pipes** and **nodes**. Fence all your pipes and nodes and then delete the fence contents.
4. Open GEOPAK Drainage
5. Open the V7 Drainage file using V8
6. You may receive some **errors or warnings** about not being able to find the **cell library** or **drainage library**. Just click **OK**.
7. Go to **Preferences>Project Components**. Select the appropriate files.
8. Go through all the **Preferences** to make sure they are set properly. Pay special attention to **Rainfall**, **Updates**, and **Plan Symbology**.
9. Go to the **Navigator** and update the graphics for the **pipes** and **nodes**.
10. Before you plot the **profiles** make sure to change the levels for the different plot elements and add the grid. Then select "Update All" under Profiles.

VI.E. Conflict Finder

Use Conflict Finder to check for vertical piping conflicts. From the main menu bar, select *Utilities* > *Conflict Finder*:



To assess conflicts, set the Conflict Finder using the workflow shown below :



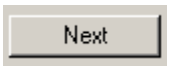
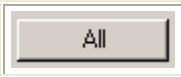
1	Check Feature	
	Select: Single Feature ID	Click the **ID** button and *data point on* a singe Drainage Link to check.

OR	Select: Drainage Links	Checks all Drainage Links for all crossings.

2	**Display Options** *(All Optional)*	
	12.34	Double-click to activate the control and set the symbology for the remaining display options.
	☑ Display Only	Views the conflict data information in temporary display mode.
	☑ Conflict Elevation	Displays the vertical elevation of the utility crossing in profile view.
	☑ Feature Elevation	Displays the vertical elevation of the main crossing in profile view.
	☑ Surface Elevation	Displays the vertical elevation of the proposed surface you stored in the preferences.
	☑ View Center	Centers the selected MS window on the conflict in plan view and/or profile views.
	☑ Edit Profile	When toggled ON, and Conflicts are found, the **Drainage Profile Edit** dialog opens to enable on-the-fly conflict resolution.
	☑ Clearance	Displays the vertical clearance (feet or meters) between the crossings.
	☑ Depth	Displays the vertical depth (feet or meters) at the crossing location.
	☑ Plan View Number: 1	Centers the MS plan view on the crossing.
	☑ Profile View Number: 2	Centers the MS profile view on the crossing.

3	**Conflicts Options**	
OR	☑ Check Drainage	Checks for Drainage pipe crossings.
OR	☑ Check Sewer	Checks for Sewer pipe crossings stored in the **Drainage Preferences** option.
OR	☑ Check Water	Checks for Water pipe crossings stored in the **Drainage Preferences** option.
OR	☑ Check Misc: ID: Gas Line	Checks for Misc Utility pipe crossings.

4	**Compute Options**	
	Compute: 1 of 2 Conflicts	Click **Compute**, the # of Conflicts found will be displayed.

		Use **Default** for Sewer clearance value you stored in the sewer line dialogs or the water line dialog, or use **Override** and supply a vertical clearance in (feet or meters).
OR		Displays the **Previous** crossing location
OR		Displays the **Next** crossing location
OR		Displays **All** conflicts

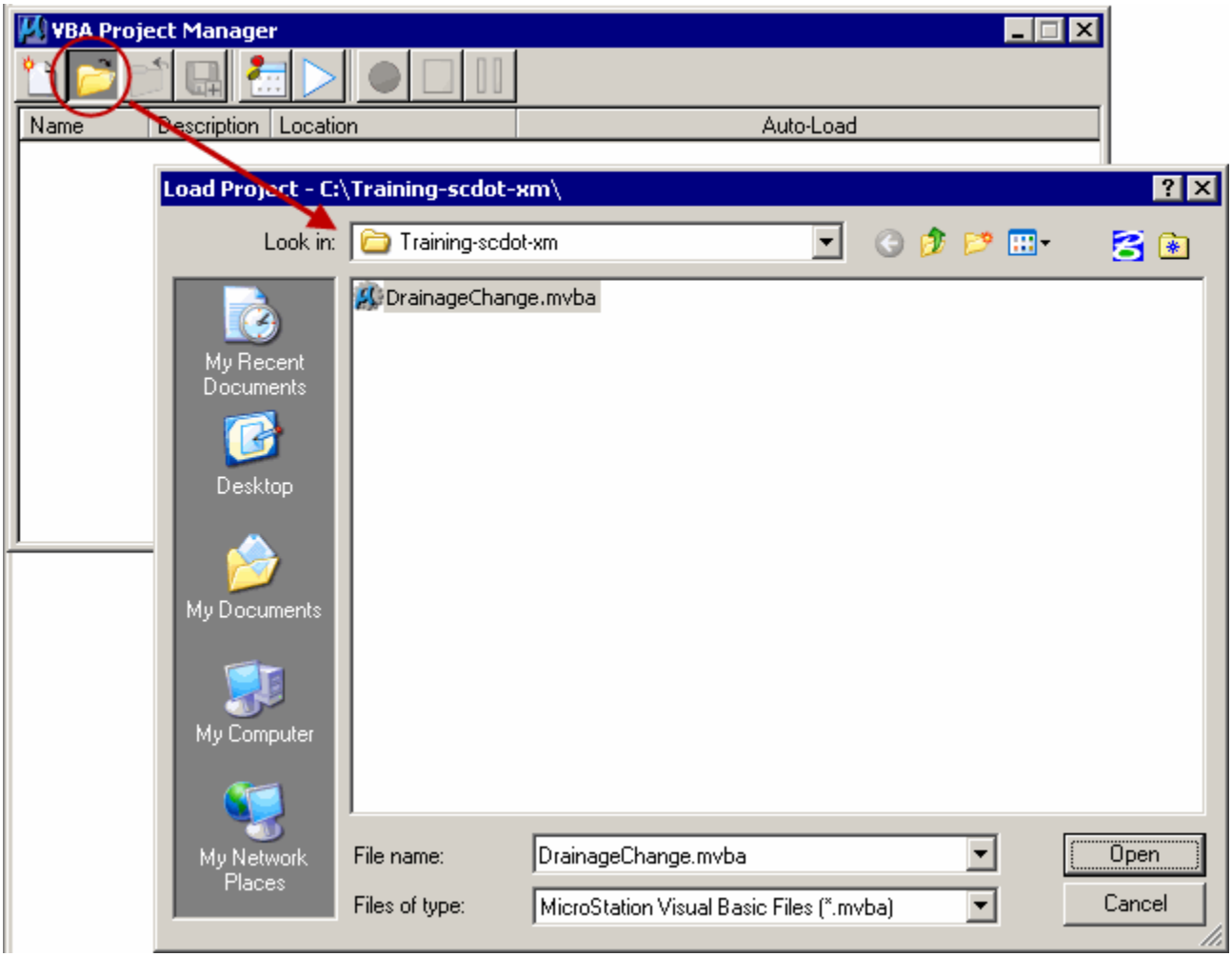
Profiles need to be drawn into the DGN file before using this tool.
To remedy conflicts, toggle **ON** "Edit Profile" and use the **Link Pipe Profile** tab to modify vertical elevations as needed.

VI.F. Alternate Pipes

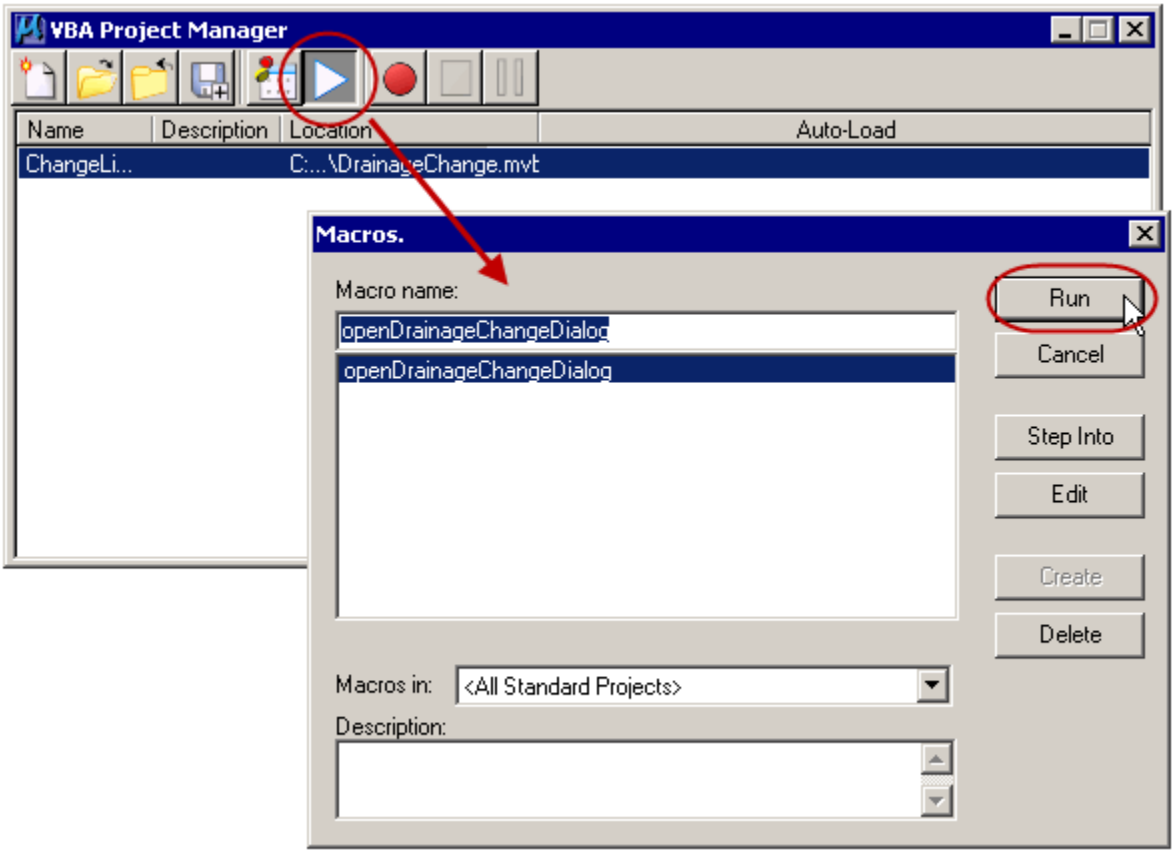
Use DrainageChange.mvba to change the pipe materials in an existing **GDF** file.

From the main menu bar, select *Utilities* > *Macros* > *Project Manager*:

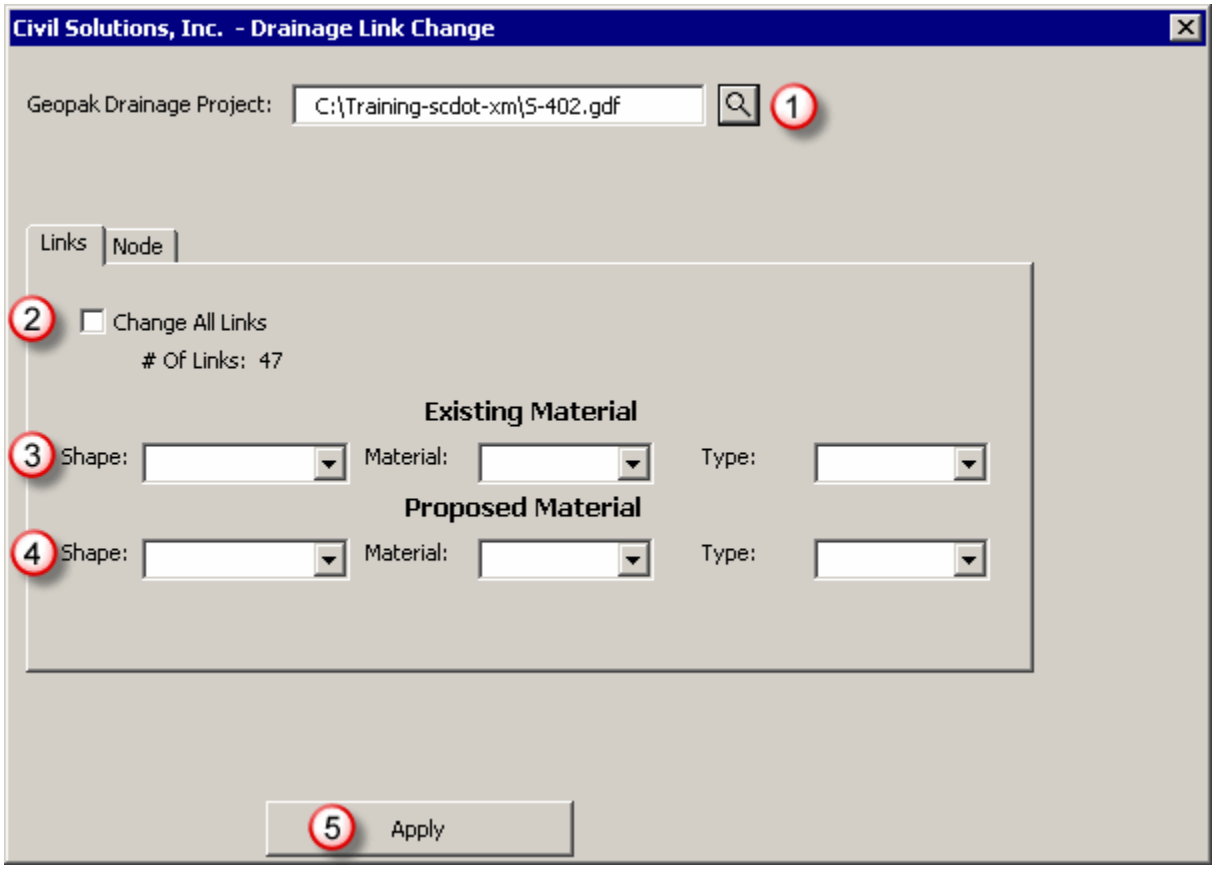
Open the DrainageChange.mvba file as shown below:



Run the DrainageChange.mvba file as shown below:



Utilize the DrainageChange.mvba file as shown below:



1	GDF File	Select the **GDF** File on which to change the pipes.
2	All Links	*(Optional)* Toggle ON to change all links within the GDF file.
3	Existing	Select the existing Link material.
4	Proposed	Select the proposed Link material.
5	Click Apply to initiate the Link material change.	

The Link materials will be changed in the current GDF file.

VII. Uploading Files

After you complete your design, you must put all pertinent information about your project on the server for the Roadway Designer to access. All the information that you must supply to them is listed under **Exchange of Information**. Below is the form that you will email to the Roadway Designer explaining where the files are located and what you named them.

This will be the only thing that you will send them electronically. They will access everything else electronically from our server. Make sure you send them a hardcopy of the abandon/retain notes.

ROAD DESIGN DATA FOR HYDRAULIC DESIGN
DATE: 8/18/2008

DESIGN GROUP:	RPG 4 - UPSTATE
PIN NO.:	36298
COUNTY:	OCONEE
ROAD/ROUTE NO.:	S-402 / SHEEPFARM RD.
PROJECT DESCRIPTION:	WIDEN (SHEEPFARM RD.) EXISTING 2 LANES TO 5 LANE CURB & GUTTER WITH BIKE LANES AND SIDEWALKS ON BOTH SIDES. CONNECT SHEEPFARM ROAD TO SC 28 (BLUE RIDGE BLVD.) WITH NEW LOCATION STARTING AT S-135 (BOUNTYLAND ROAD).
ADDITIONAL NOTES:	S-135 WILL BE WIDENED TO 5 LANE CURB & GUTTER AT THE INTERSECTION WITH SHEEPFARM ROAD. IT WILL THEN TIE BACK TO THE EXISTING PAVEMENT. STONEBROOK DRIVE WILL HAVE A VALLEY GUTTER. ALL OTHER SIDE ROADS WILL HAVE DITCH SECTIONS.

FILE INFORMATION

	SERVER	DESIGN GROUP	COUNTY	PIN
FILES LOCATED:	NTS/HQ/Precon/	RPG 4	OCONEE	36298
'.GPK' FILE(S):	JOB298.GPK			
'PP' FILE(S):	R36298PP.DGN			
'PF' FILE(S)	R36298PF1.DGN		S-402 (SHTS. 6 - 13)	
	R36298PF2.DGN		SIDE ROADS (SHTS. 14 - 23)	
	R36298PF3.DGN		SIDE ROADS (SHTS. 24 - 26)	
'.NEW' FILE(S):	36298.NEW			
	36298A.NEW			

CHAIN NAME	PROPOSED PROFILE	DESCRIPTION
S402REL	S402RFP	CENTER LINE GRADE S-402 RELOCATION
US76		CENTER LINE US 76
BROOKLANER	BROOKLANERFP	CENTER LINE GRADE BROOK LN. REL.
STONEBROOKR	STONEBROOKRFP	CENTER LINE GRADE STONEBROOK DR. REL.
S135REL	S135RFP	CENTER LINE GRADE S-135 RELOCATION
SPRINGWOOD		CENTER LINE EAST SPRINGWOOD DR.
OCONEER1	OCONEER1FP	CL GRADE OCONEE ESTATES REL. PART 1
OCONEER2	OCONEER2FP	CL GRADE OCONEE ESTATES REL. PART 2
ALBERTSR	ALBERTSRFP	CENTER LINE GRADE ALBERT'S RD. REL.
PAULGILLR	PAULGILLRFP	CENTER LINE GRADE PAUL GILLISON RD. REL.
SC28		CENTER LINE SC 28

TANGLEWOOD		CENTER LINE TANGLEWOOD DR.
STREAM1		CENTER LINE OF STREAM #1
STREAM2		CENTER LINE OF STREAM #2
STREAM3		CENTER LINE OF STREAM #3
STREAM4		CENTER LINE OF STREAM #4
STREAM5		CENTER LINE OF STREAM #5
STREAM6		CENTER LINE OF STREAM #6

CHAIN NAME	CROSS SECTIONS	DESCRIPTION
S402REL	S402REL_DX_SCALED.DGN	STA. 10+00.00 - 114+64.38
US76	US76DX.DGN	STA. 10+50.00 - 20+00.00
BROOKLANER	BROOKLANERDX_SCALED.DGN	STA. 10+35.87 - 16+27.98
STONEBROOKR	STONEBROOKRDX_SCALED.DGN	STA. 10+35.92 - 15+94.48
S135REL	S135RDX_SCALED.DGN	STA. 10+00.00 - 42+79.57
SPRINGWOOD	SPRINGWOODDX.DGN	STA. 10+12.71 - 15+57.93
OCONEER1	OCONEER1DX_SCALED.DGN	STA. 10+30.38 - 16+00.00
OCONEER2	OCONEER2DX_SCALED.DGN	STA. 36+00.00 - 41+26.31
ALBERTSR	ALBERTSRDX_SCALED.DGN	STA. 7+00.00 - 12+22.35
PAULGILLR	PAULGILLRDX_SCALED.DGN	STA. 15+02.15 - 19+01.89
SC28	SC28DX.DGN	STA. 648+00.00 - 660+00.00
TANGLEWOOD		

If you have revisions to your **GDF** file and must resubmit files to Roadway Designer, resend them the email and state what changes were made. Be specific and name the **pipes** and **nodes** that were affected. If a large section of roadway was affected then give road stations that define the limits of those changes.

Consultants will still need to submit all files to the Hydraulic Engineer by a CD or FTP for the Roadway Designer's use and a hard copy of the plans for our review. Labels will still be required for all pipes and basins, but they are to be very basic. The Roadway Designer will do the final labels themselves for both Right-of-Way and Construction plans. Also include the spreadsheet on the previous page in the submittal and the Hydraulic Engineer will forward it to the Roadway Designer.

VIII. Troubleshooting

Here are some common problems that are easy to correct. Check here before panicking and thinking that the program has gone haywire.

If your problem is not listed below, call your coordinator for help.

Cannot find Cell Library	Make sure that all of your drives are connected. You may have to copy the cell library and put it in your project directory. Make sure to update the project components.
Cannot find Land Use	Say OK and ignore
No active network selected	Got to Network>Active Network
Basins appear on screen but not in program	Make sure that you have the correct project open and pertinent levels on
Discharge is equal to 0 0	Check to be sure that the rainfall data matches the frequency option under Preferences
Flow line of downstream pipe is higher than flow line of upstream pipe	Make sure that you have the correct pipe sizes listed for all existing pipe or make sure design is selected new pipe
The nodes/links that I deleted are still on the screen	Go to Navigator and do a Graphic Update
Some nodes/links that I did not want deleted are not on my screen anymore but are in the Navigator	Go to Navigator and do a Graphic Update
When I hit Graphic Update only one nodes/link changed	Be sure to highlight everything that you want changed in the Navigator window
I have input 5 nodes/links where are they	Be sure that you are choosing Add after you enter all information and choosing Component > Node/Link > Add to create a new node/link. Also check to see if the level is on
I cannot see my labels	Check Preferences to see if you have labels checked. Do a Graphic Update. Check the label offset in Preferences.

The program keeps changing my set elevations/slopes	Check to see if your envelopes are large enough to accommodate the elevations you chose. Or you may need to make one of your nodes a drop box
I referenced my pp.dgn file, but I cannot see it on the screen	Go to File>Reference and make sure that there is an X under the Display column
The Macro for running reports didn't ask me to enable and it will not let me run nodesum and linksum reports.	In EXCEL go to Tools>Macro>Security. Make sure the security level is set to medium.
It keeps changing my held elevations and saying that I have exceeded the min deep at the basin	You may need to change that node to allow drop manholes instead of match soffit elevations. Your held elevations are making it impossible for your inflow and outflow pipes to have matching soffits. The program changes the elevations to match the specifications that you have set
Design/Analyze is grayed out	Got to Network Active Network and choose the network you want to run
When I try to move a piece of text in the profile the whole profile moves	Go to Settings/Locks/Graphic Group
It will not update my nodes. It says cannot find the cell library.	Download the cell library to your project directory and select it again in Preferences.

Appendix A- Reports

The following information is preset in our **DRF files**.

Interoffice Report

Our interoffice report will contain the following information:

- Node Report

File name: nodestandard.drf

Node Information:
1. I.D.
2. Description
3. Type
4. Library Item Name
5. Reference PGL
6. Station
7. Offset
8. Reference Elevation
9. Elevation
10. Depth
11. Junction Loss
12. Tc Used
13. Cumulative Tc
14. Cumulative Discharge
15. Cumulative Area
16. Cumulative C Value
17. Cumulative Intensity

- Area Report

File name: areastandard.drf

Area Information:

1. I.D.
2. Tc Used
3. Discharge
4. Intensity
5. Composite C Value
6. Composite Area
7. Total Subarea C Value
8. Total Subarea
9. Remainder C Value
10. Remainder Area

- Link Report

File name: linkstandard.drf

Link Information:

1. I.D.
2. Upstream Node
3. Downstream Node
4. Shape
5. Material
6. Number of Barrels
7. Rise
8. Actual Length
9. Slope
10. Discharge
11. Capacity
12. Uniform Depth
13. Uniform Velocity
14. Soffit Upstream
15. HGL Upstream
16. Soffit Downstream
17. HGL Downstream
18. Invert Upstream
19. Invert Downstream
20. Actual Velocity Upstream
21. Actual Velocity Downstream
22. Actual Depth Upstream
23. Actual Depth Downstream

Roadway Report

Road Design's report will contain the following information:

- Link Report

File name: linkstandardroad.drf

Link Information:

1. I.D.
2. Library Item
3. Type
4. Material
5. Shape
6. Upstream Node

7. Downstream Node
8. Actual Length
9. Slope
10. Rise
11. Pay Item
12. Invert Upstream
13. Invert Downstream

- Node Report

File name: nodestandardroad.drf

Node Information:

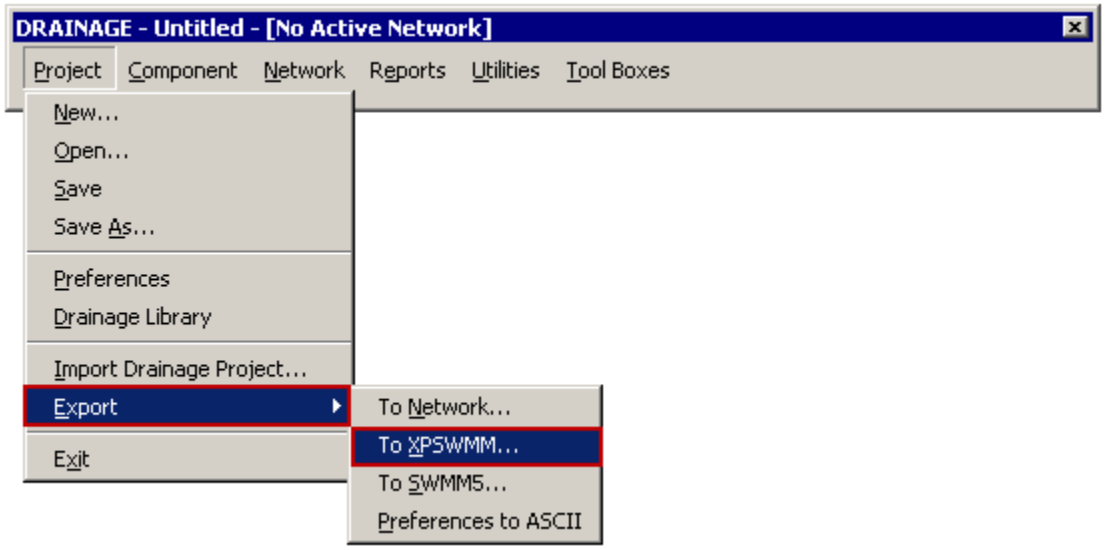
1. I.D.
2. Library Item Name
3. Reference PGL
4. Station
5. Offset
6. Elevation
7. Depth
8. Pay Item

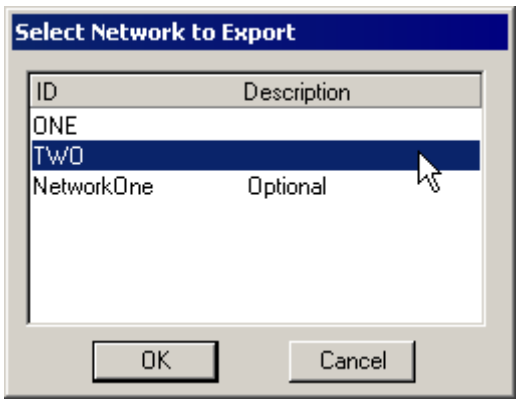
Appendix B- Import/Export

This section covers the import & export of XMSWMM, Google Earth, and DEM files.

XPSWMM

To Export any **Network** of the current Drainage **GDF file**:





The **Network** is now available for import into XPSWMM.

Google Earth

Exporting to Google Earth requires a 3-step procedure:

1. Use Google Earth to add & save a Placemark
2. Use MicroStation to Define the Google Earth Placemark Monument
3. Use MicroStation to Export the Google Earth File

- Add/Save Placemark

Use Google Earth to add & save the Placemark:

1. Zoom to your desired location in Google Earth.
2. From Google Earth, select Add > Placemark (enter the name; verify the latitude & longitude are correct).
3. Right-click on the Placemark, select "Save Place As" and save as the KML or KMZ (the Z means zipped format and is thus a smaller file) to a folder on your local computer or server.

- Define Placemark

In MicroStation, select Tools>Google Earth:

1. Zoom to your desired location in MicroStation (corresponding to step 1 in **add placemark**).
2. In MicroStation's Google Earth toolbar, click "Define Google Earth Placemark Monument", and snap to the location in step #1 above.
3. In MicroStation's "Select Monument Placemark File" window, select the saved placemark file (from step 3 in **add placemark**).

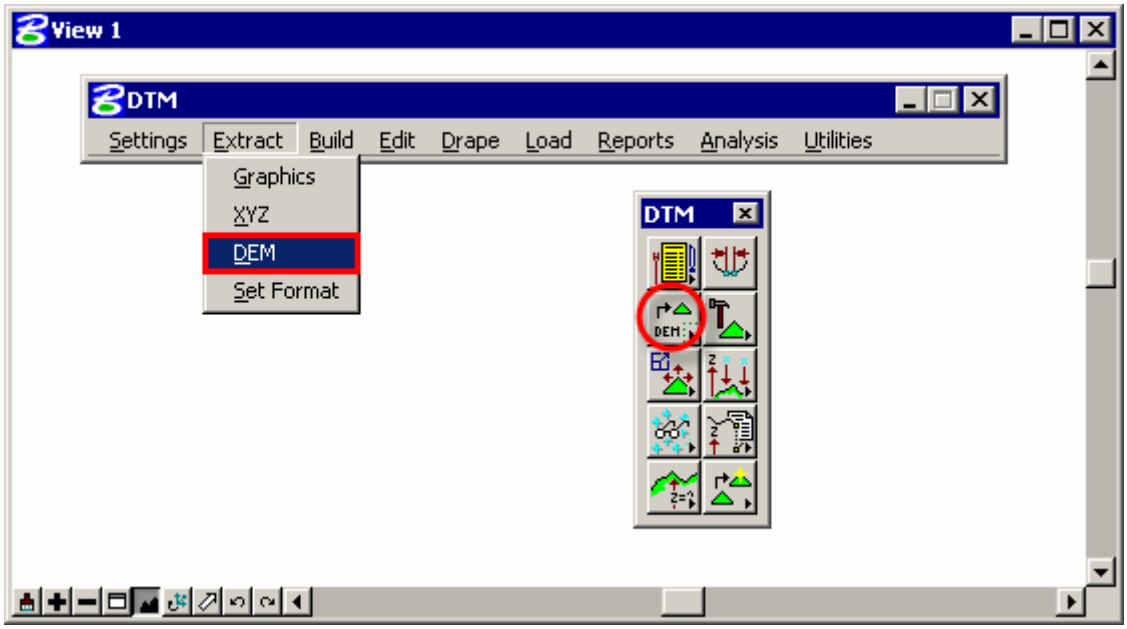
- Export KML

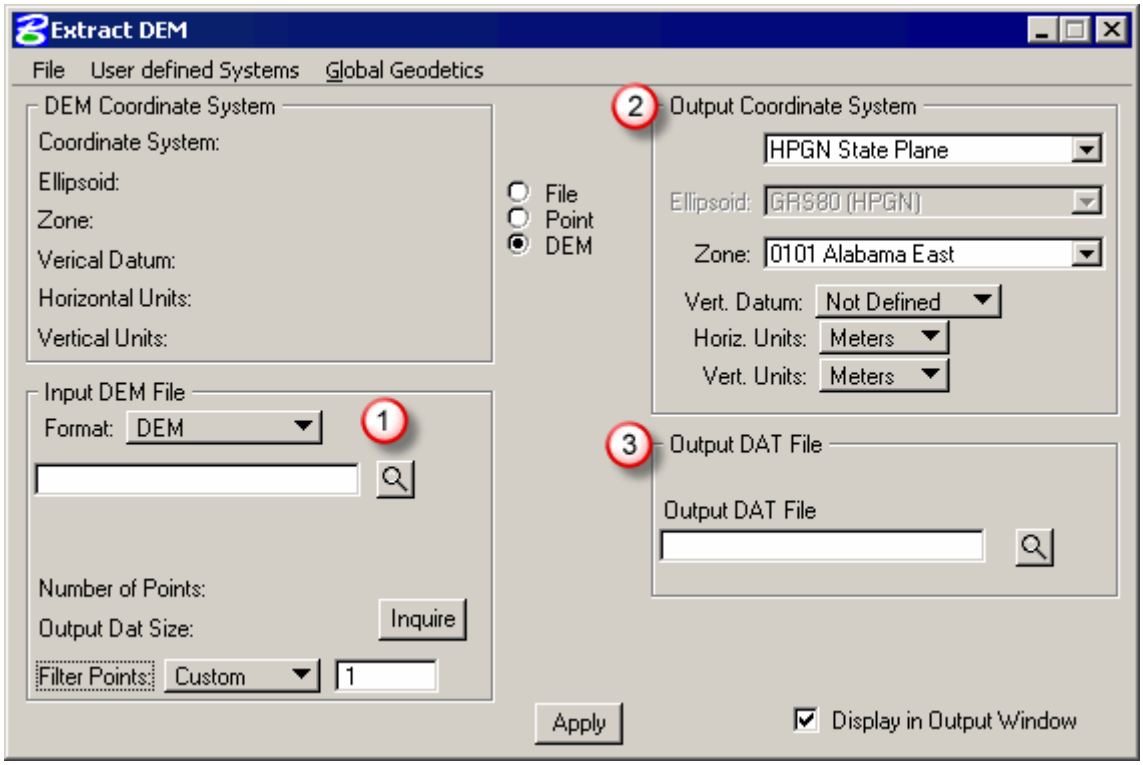
In MicroStation, select Tools>Google Earth (if not already open):

1. In MicroStation's Google Earth toolbar, click "Export Google Earth (KML) File" and key-in the name of the (KML or KMZ) file to export to Google Earth.
2. After clicking OK, Google Earth should automatically open (if not open already) and the cad elements will be exported into the Google Earth view at the proper location.

DEM

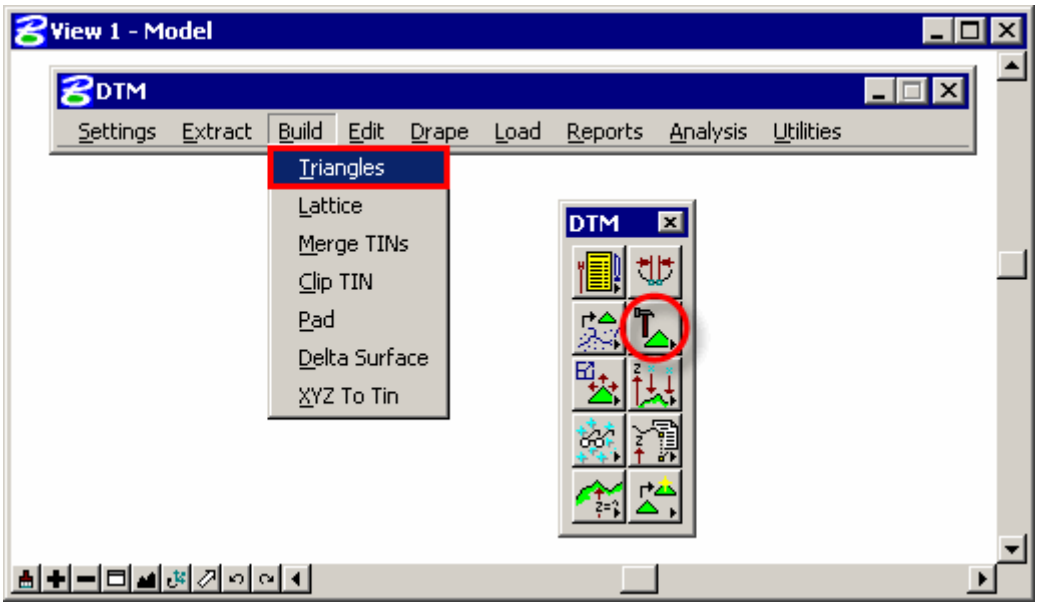
To extract a **DEM file** into a **DAT File** for subsequent creation of the **TIN file**, select from the DTM menu bar *Extract* > *DEM:*

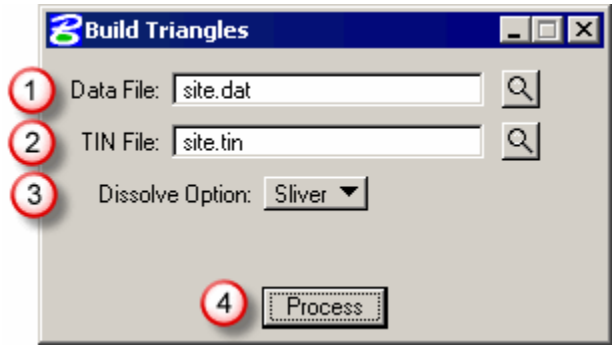




1	DEM File	Select the **DEM file** from which to extract data
2	Output Coord	Set the Output Coordinate System
3	Output DAT	Select the **DAT File** to be created

Now to build the Triangulated Irregular Network **TIN file**, select from the DTM menu bar *Build > Triangles:*





1	Data File	Select the **DAT** file created above
2	TIN File	Select the **TIN** file to be created
3	**Dissolve Options**	
	None	None of the external triangles are dissolved

OR	Sliver	Long "thin" triangles are dissolved
OR	Side	Enter a side length to dissolve triangles longer than the length entered
	Click  to initiate the creation of the TIN file	